VIDIA RTX 2080 + Ti COMPARISON THE NEW GPU KING

apc

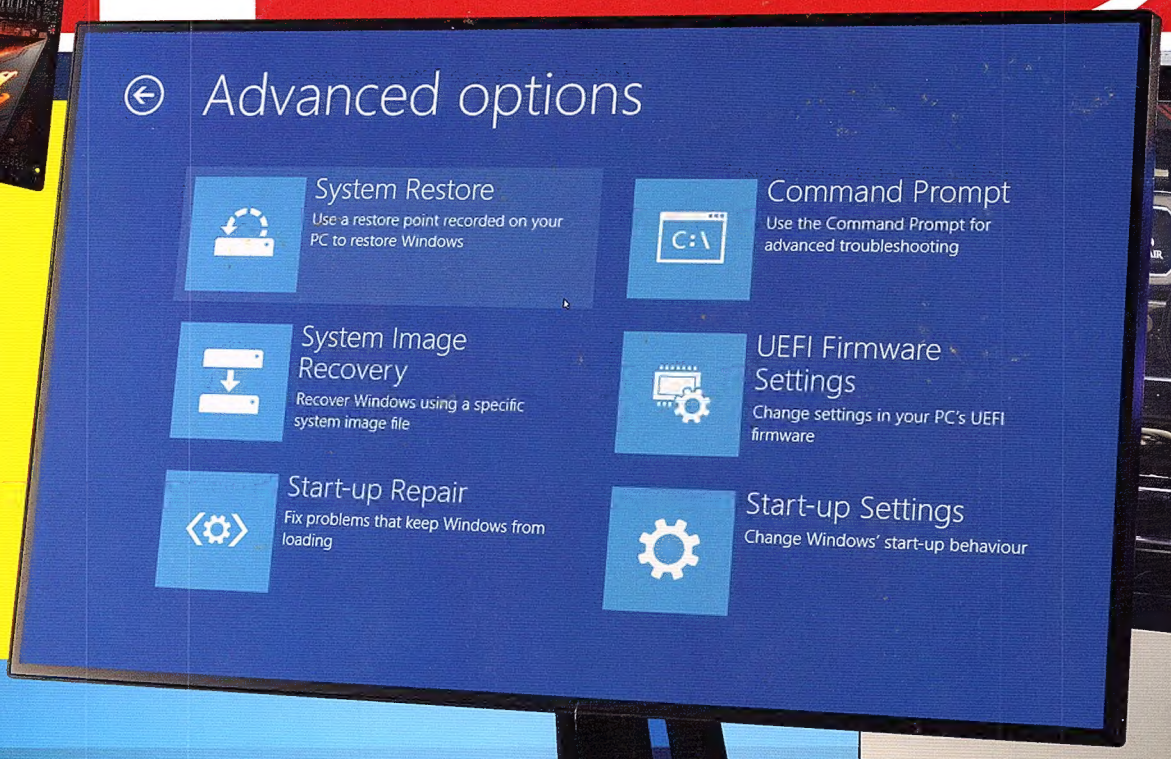
Dec 2018
Issue 461

NOW INCORPORATING PC & TECH AUTHORITY

YOUR EXPERT GUIDE TO TODAY'S TECH

S INTEL'S 9TH-GEN GOOD ENOUGH?

REVIEWED:
CORE i9-9900K CPU
- Z390 MOTHERBOARDS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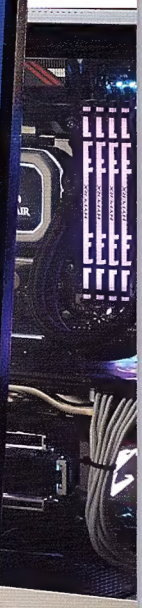

WINDOWS 10 DIY REPAIR GUIDE

MAKE YOUR PC RUN LIKE NEW AGAIN • FIND & FIX WINDOWS' MOST ANNOYING PROBLEMS • **TAKE CONTROL OF WINDOWS UPDATE** • OPTIMISE YOUR LAPTOP & DESKTOP

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NBN SMB Solution for VDSL2 & Ethernet WAN
(FTTN/B, FTTP, HFC, Fixed Wireless, Satellite)

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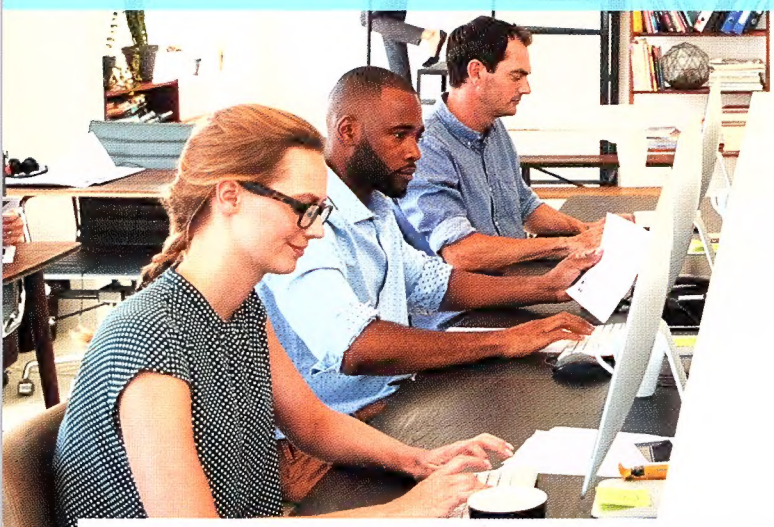

Vigor2862 Series

Multi-WAN VDSL2/ADSL2+ & Gigabit Ethernet WAN Firewall router with 32 x VPN tunnels, 802.11ac (AC2000) Wi-Fi and VoIP

Vigor2862Vac

- VDSL2/ADSL2+, Gigabit Ethernet WAN port, Dual USB ports for failover and load-balancing
- Two USB 2.0 ports for connection to two 3.5G/4G LTE USB mobiles, FTP server and network printer
- 4 x Gigabit LAN ports with multiple subnets and 50,000 NAT sessions
- Integrated IEEE 802.11ac (AC2000) wireless Access Point; dual band; up to 1.7Gbps throughput
- IPv6 & IPv4
- Increased IP addresses (1022) and IP subnets (8)
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- Central AP Management for deployment of multiple wireless VigorAPs
- Works with Smart Monitor Network Traffic Analyzer (30-nodes)
- Works with VigorACS 2 Central Management for multi-site deployment

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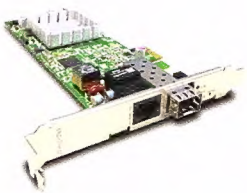
Vigor2762Vac

- 1 x VDSL2/ADSL2+ WAN port
- 1 x selectable Gigabit WAN/LAN port
- 4 x Gigabit Ethernet LAN ports with 30,000 NAT sessions
- 2 x USB ports for 3G/4G LTE mobile broadband access, USB printer and storage
- VDSL2 vectoring
- IPv6 & IPv4
- Object-based SPI Firewall, CSM (Content Security Management) and QoS for network security
- 2 x VPN tunnels including 2 x SSL-VPN tunnels
- Integrated IEEE 802.11ac (AC1200) wireless Access Point
- SIP VoIP (2 x FXS ports)
- Works with VigorACS 2 (Central Management System)

VigorNIC 132F

VDSL2/ADSL2+ PCI Express NIC with SPI Firewall and SFP secondary WAN port



- 1 x VDSL2/ADSL2+ WAN port
- 1 x SFP port for optic fibre or UTP interface module
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Object-oriented SPI Firewall
- IPv6 & IPv4
- Support Windows 8, Windows 10 & Ubuntu
- Multi-PVC for triple-play application
- VigorACS 2 management system

Vigor130

VDSL2/ADSL2+ modem/router

TAIWAN EXCELLENCE 2014

- 1 x VDSL2/ADSL2+ WAN port
- 1 x Gigabit Ethernet LAN port
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Object-oriented SPI Firewall
- IPv6 & IPv4
- Works with VigorACS 2 management system

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Welcome to a bright future

In which we share our love of the PC and all things tech, right here.

Hello readers. I'm the new editor and it's an honour and privilege to be here. Dan has been the editor of *APC* since June 2013, which, as it happens, was roughly the same time I took over as the editor of *PC & Tech Authority* magazine. For each and every month of those years since, we've been engaged in a friendly rivalry and it's been good fun. I would studiously pore over each new issue of *APC* magazine to see what they were up to, and I respected and admired everything Dan and *APC* did.

It was a very friendly battle, with hardly a month passing when I didn't bump into one of the *APC* team at an event and share a laugh about who had the nicest issue that particular month. Magazine making is an extremely satisfying craft and I worked hard with my team to make *PCTA* as good a PC mag could as it could be, as did Dan, here on this mag.

The truth is that *APC* and *PCTA* had an awful lot in common. Each strove to cover the ever changing tech landscape and keep you informed. We each went about our product testing in much the same way, and managed to come up with terrific guides to help you get the most from what you have. Thus, it makes undeniable sense that there be just one PC magazine in Australia in which we can focus our combined experience.

This is *APC*, and it always will be. It has always evolved, though at a civilised pace, and that's not about to change. It's a true legend of the publishing scene and it's equally a very important part of many people's lives, having provided outstanding reviews, guides, features and opinions since 1980. I was an early fan myself and read it religiously every single month in the late 1980s and early 90s when I was properly getting into computers. And now, here I am at the helm and it's a wonderful feeling. I am humbled by *APC*'s legacy and proud to carry it on.

We've already made a couple of tweaks to the format. Nothing dramatic because this boat doesn't need much rocking. From *PCTA* we've added the Market Watch and System News pages, and they live within a new PC Builder section. Many of the best *PCTA* writers can now be found in these pages, like Chris Szewczyk, Anthony Agius, Nick Ross, and Mark Williams, complementing the supreme team already in place.

It's a true delight to be here and I hope our efforts please you – being the existing *APC* readers combined with those we welcome from *PCTA*. We're all the same. We love the PC, we're addicted to following its ever-fascinating evolution and to the future I say only good times are ahead. Do please feel free to reach out on any topic via my email below! ■

BEN MANSILL
EDITOR
ben.mansill@futurenet.com

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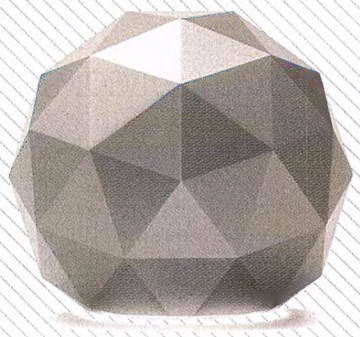

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TURN THE PAGE FOR YOUR EXCLUSIVE FREE SOFTWARE OFFERS

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» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

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Please note that these exclusive *APC* & *TechLife* magazine downloads will only be available for a limited time, from **05/11/2018 to 23/12/2018**

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EXCLUSIVE GIFT 02

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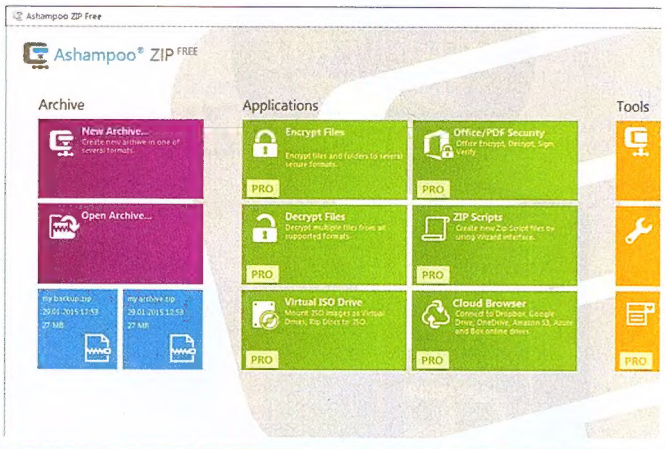

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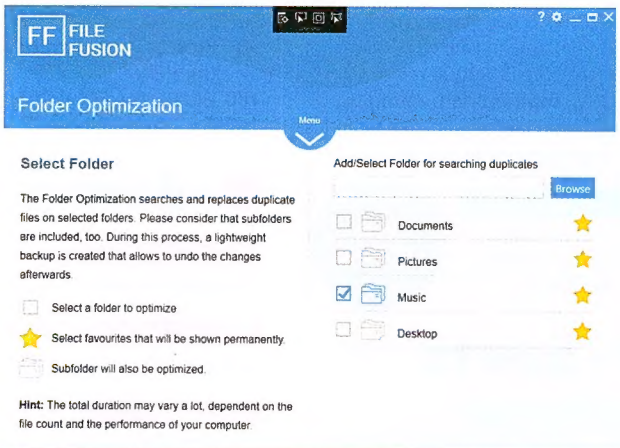
FF FILE FUSION
Folder Optimization
Menu
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Add/Select Folder for searching duplicates
Browse
The Folder Optimization searches and replaces duplicate files on selected folders. Please consider that subfolders are included, too. During this process, a lightweight backup is created that allows to undo the changes afterwards.
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Music
Desktop
Select a folder to optimize
Select favourites that will be shown permanently
Subfolder will also be optimized
Hint: The total duration may vary a lot, dependent on the file count and the performance of your computer

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*Compared to Samsung LC34H890WJEXXY. ^Compatible devices sold separately. Screen images simulated.

technotes

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Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

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TRUE GAMING

Apple's teen hacker escapes jail time

EIGHT-MONTH PROBATION REPLACES CONVICTION.

The Melbourne youngster who broke into Apple's so-called secure mainframe has been granted an eight-month probation, with the judge ruling that no conviction will be recorded. The teenager was 16 when he hacked into Apple's network, but the now 19-year-old will not serve any time in jail. Instead, he has been accepted into university, where he will study criminology and cyber safety. SS

Google+ is being scuttled following disastrous data breach

STRUGGLING SOCIAL NETWORK GETS A MINUS FOR SECURITY.

Google has announced it's kicking its floundering social media platform Google+ to the curb after a Wall Street Journal report revealed that the tech giant had been hiding the news of a massive security breach on the platform. The breach, caused by an API, left the personal information of about 500,000 users exposed, although Google insists there is "no evidence that any developer was aware of this bug, or abusing the API". SS

Australian consumer watchdog slams tech giants over fake celebrity ads

FACEBOOK AND GOOGLE TOLD TO CLEAN UP THEIR ACT.

According to Scamwatch, celebrity endorsement scams in Australia have increased by 400%, resulting in financial losses for consumers that have gone up by an eye-watering 3,800%. The amount of money lost by consumers to fake ads in 2018 alone add up to $142,000. "Most of the reports to Scamwatch involve these scam advertisements running on Google ad banners or as ads in Facebook's news feeds," says ACCC's deputy chair Delia Rickard. She wants the "tech giants to do more to quickly suspend ads" so consumers don't "risk losing money". SS

The biggest Facebook hack yet

Fifty million accounts left completely open.

There has been another huge security breach at Facebook, the worst in its history. Engineers noticed unusual activity on September 16, worked out what was going on nine days later, and two days after that closed down the breach. Up to 50 million accounts are said to have been compromised; it is unsure for how long.

The hackers exploited an interaction between three software bugs, and the flaw dates back to July 2017, with the introduction of the "View As" feature – ironically, partially a privacy tool. Using it creates keys, called access tokens, which enable people to reconnect to their accounts without using passwords. It was these tokens that were spirited away.

Armed with a token, a hacker could pose as the account holder, and the account be laid open. The potential for mischief is alarming, although there have been no reports of tampering with posts, but there are signs of profile data being accessed.

The attack was sophisticated, and no group has been linked to it, leading to speculation about the source, including the possibility of involvement by state-sponsored groups. Facebook is working with the FBI to track the culprits, but results aren't expected quickly, if at all.

"We have a responsibility to protect your data, and if we can't, then we don't deserve to serve you," so said Mark Zuckerberg after the data harvesting by Cambridge Analytica earlier this year. On this hack he was "glad we found this, but it definitely is an issue that this happened in the first place." The lack of tangible damage has helped minimise the public relations storm; stock prices dipped, but nothing like the 18 percent drop in the summer.

When questioned about the issue during his testimony before Congress in April, Zuckerberg said, "We have to do a lot of work about building trust back." It appears this is still the case. With great data comes great responsibility.

"The attack was sophisticated, and no group has been linked to it, leading to speculation about the source, including the possibility of involvement by state-sponsored groups."

20 YEARS IN THE MAKING

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"The Level 20 GT walks a fine line between gaming prestige hardware and simple enthusiast aesthetic"

- David Hollingworth, Editor of PC PowerPlay

thermaltake

> Find out more at tiny.cc/Level20Family

Online piracy on the rise again, thanks to video streaming exclusives

GOOD WORK UNDONE.

After years of aggressive anti-piracy lobbying by content creators and blocking of sites by ISPs, internet piracy was on the decline, but a new report from networking company Sandvine claims it's on the rise again. The cause? Streaming services like Netflix and Amazon producing exclusive content. Shows like *Game of Thrones, Stranger Things* and *Man in the High Castle* aren't available on all platforms, leading to a rise in illegal downloads.

Aussie government to introduce new 'rapid takedown' anti-piracy legislation

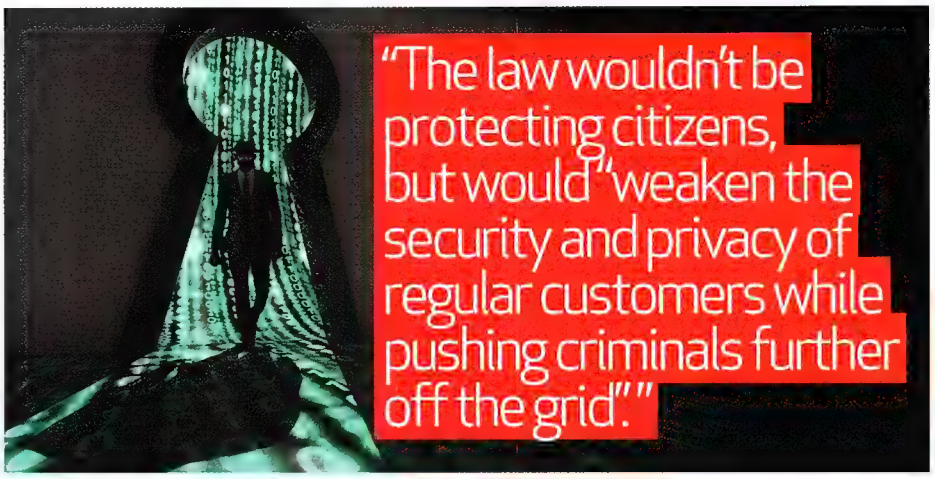
AIMS TO QUICKLY KILL TORRENTS AND OTHER PIRATE LINKS.

The Australian government's crackdown on online piracy continues as, at the time of writing, it prepares to introduce new legislation to Parliament. The proposed law will force search engines – Google, Yahoo and Bing, for example – from allowing torrent sites to appear in search engines. Village Roadshow boss Graham Burke calls the action a "game-changer", adding that search engines are "unashamedly facilitating crime" by promoting piracy sites. SS

Tiny Spy Chips in Servers?

STEALTH AND SKULDUGGERY

Has the Chinese state secretly put spy chips into Supermicro servers during manufacture? Have these servers been used by major companies and even government departments? That's the alarming news in a report from Bloomberg Businessweek. It claims the chips were uncovered in 2015 after a breakdown of hardware on behalf of Amazon. The authorities were informed, but not the public, and a lot of servers quietly sold off. The news has been strongly denied by Apple, Amazon, Supermicro, and the Department for Homeland Security. Bloomberg says it has 17 highly placed anonymous insiders who have confirmed the story. Surely, there's more come....


"The law wouldn't be protecting citizens, but would "weaken the security and privacy of regular customers while pushing criminals further off the grid"."

Australian surveillance laws bad for global internet security, claim critics

Tech giants come out swinging against the proposed law.

The Australian government has, so far, received 31 formal submissions from tech giants and experts speaking out against the proposed Assistance and Access Bill. While the government claims the law won't require companies to build backdoors into their encrypted messaging platforms, the tech giants disagree. A private industry body called The Digital Industry Group, representing Google, Facebook and Twitter, says that allowing law enforcement to access private messages would open a can of worms, potentially exposing users to hacking. Cisco also agrees that the vaguely worded law could strong-arm companies into creating backdoors, something CEO Chuck Robbins promised never to do.

Apple has criticised the law as "dangerously ambiguous" and "alarming to every Australian". According to the Cupertino firm, the law wouldn't be protecting citizens, but would "weaken the security and privacy of regular customers while pushing criminals further off the grid". Mozilla is worried about the integrity of its open-source software, saying it would "need to close portions of its source code and/or release builds that are not made from its publicly released code bases", which "is at odds with the core principles of open source, user expectations, and potentially contractual license obligations". **Sharmishta Sarkar**

Google to help state tracking

In the proposed Chinese version, anyway.

Google's Dragonfly project, its customised search engine for the Chinese market, continues to attract controversy. The latest revelation is that the prototype search engine links all enquiries to user's phone numbers, so all searches are easily linked to individuals. It has also emerged that there are blacklists for censorship (including knowledge on human rights, and even "Nobel Prize"), as well as provision for falsified air pollution results.

The Chinese market is huge, and therefore lucrative, but the cost of participation includes an ethical element that some find hard to swallow, including many of Google's own employees, human rights organisations, and the White House (it has called for the project to be dropped). China is building a system of citizen surveillance second to none, and Google's participation is starting to look less like a business opportunity, and more like complicity in state control. Google has been reluctant to comment on Dragonfly, even to the Senate Intelligence Committee.

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numbercrunch

» WE LOOK AT THE NUMBERS DRIVING THE BIG TECH NEWS

$139 million

ESTIMATED COST OF DISNEY'S NEW LIVE-ACTION STAR WARS TV SERIES – or $13.9 million per episode for each of the ten episodes in the first season. The aim is to create a series that will have the same high production values as Disney's Star Wars cinema releases, making it one of the most expensive TV productions ever created.

$27 BILLION

AMOUNT OF MONEY SAMSUNG'S PLANNING TO INVEST IN ARTIFICIAL INTELLIGENCE (AI), 5G MOBILE AND CAR TECH OVER THE NEXT THREE YEARS.
The Korean tech giant is also recruiting over 40,000 people, 1,000 of which will work in AI research. Oh, and that's Australian dollars!

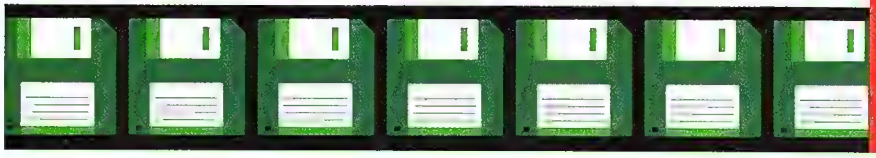
50

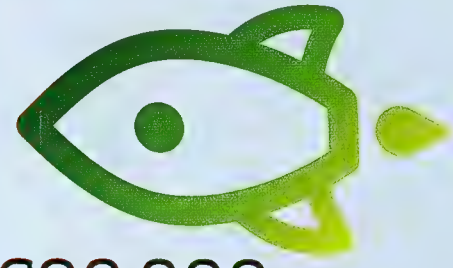
NUMBER OF EYE DISEASES THAT CAN ACCURATELY BE DETECTED BY GOOGLE'S DEEPMIND AI.
Thanks to research carried out at Moorfields Eye Hospital in London. 15,000 optical coherence tomography (OCT) scans from 7,500 patients – along with expert diagnoses from eye doctors – were used to train the software. The technology could eventually be used in hospitals, once it is passed for clinical use.

32 terabytes

MAXIMUM STORAGE CAPACITY OF INTEL'S FORTHCOMING DC P4500 SOLID-STATE DRIVE (SSD).

Destined for datacentres, the ruler-shaped drive boasts an ultra-thin form factor and needs half the airflow of a regular SSD. It also uses one-tenth of the power.



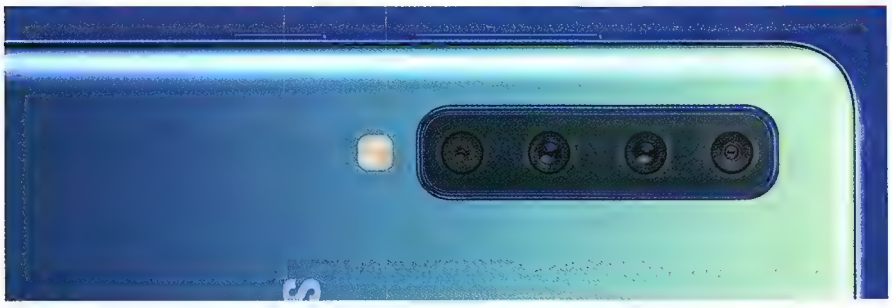


690,000

SPEED, IN KILOMETRES PER HOUR, OF THE PARKER SOLAR PROBE.
This recently took off from Cape Canaveral. The Probe will travel to within 6.16 million miles of the Sun – close enough for temperatures on the ship's surface to reach 1,377-degrees Celsius; and the closest that any 'ship has been to the surface of our galaxy's star. So far...

techbrief

» SHARMISHTA SARKAR TAKES A DEEPER LOOK AT A TRENDING NEWS TOPIC



Changing trends in digital photography

With the latest smartphones, everyone's a photographer. But how is that, and the rise of mirrorless cameras, affecting the photography industry?

Everyone loves to take a picture, and equipped with one of the latest smartphones, everyone indulges, even if it's just selfies. The photography industry is booming, changing just as fast as any other tech, with innovations in both software and hardware taking photographers – amateurs and pros alike – on an exciting journey through a changing landscape. Smartphones seem to be gaining more lenses with each passing year, mirrorless cameras are giving DSLRs are run for their money, and action and aerial photography are becoming more and more mainstream. Then there's the tech powering the cameras – the use of machine learning is adding additional dimensions to this artform, giving photographers the means to be creative without too much effort. And, with the final product on hand, you'll need to ask yourself this: is social media changing the way we appreciate photography?

The next stage of innovation in smartphones: the camera

More lenses than you'll ever need.

The Huawei Mate 20 Pro features three rear cameras, with the main f/1.8 lens boasting a 40MP resolution. Samsung has taken the game to the next level, launching the Galaxy A9 with four rear lenses – one 24MP lens, a 2x telephoto lens, an ultra-wide and a depth lens. If you thought that was enough, think again. Camera maker Light has taken the concept the furthest, working on a prototype that has a whopping nine lenses! With each new smartphone entering a saturated market, it seems the only arena phone makers can compete in is the camera. Used with improving software and apps, we could be saying goodbye to the travel camera soon.

Is the death of the DSLR nigh?

Mirrorless camera sales are on the rise.

There was a time when DSLRs outperformed mirrorless cameras, but the tables have turned. With Sony leading the way, the case for mirrorless snappers have become strong – they're lighter, boast excellent burst speeds and can match, if not exceed, the battery life of most DSLRs. Canon and Nikon have also gone down the mirrorless path, releasing new full-frame mirrorless ILCs to compete with Sony. According to the Camera and Imaging Products Association (CIPA), has mirrorless cameras outsold DSLRs in 2017 – there was a 30% increase in mirrorless sales, while DSLR shipments dropped by 10%. However, the shift towards mirrorless is slow albeit steady, with experts predicting DSLRs will be around for a while yet.

Film photography is making a comeback

It's back to the dark room.

Vinyl isn't the only old-school item making a comeback. There's an increasing trend among photographers to reach for a film camera, with a growth of 5% year on year globally. And it seems it's the millennials who are going retro. A survey conducted three years ago found that 30% of film users were under 35, while 60% had started using film in just the last five years. And that trend continues, with more and more stores catering to all things film. While Kodak has announced the release of its Ektachrome films, Netflix is helping popularise the medium by releasing a film called Kodachrome, which celebrates the longest surviving brand of colour film.

Instagram is changing the way we take photos

A whole new perspective.

Social media is a great way for us to communicate via images. It has also sparked the race for the perfect Instagrammable photo. People are taking risks to grab the best perspective by getting to the edge of a cliff or standing in the path of an oncoming train. Endangering life isn't worth the perfect shot, but Instagram has started a revolution amongst the average user. Where lighting was the purview of the professional at one point, Instagram users have begun thinking in terms of shadows, colours, and presentation in general. Instagram users are increasingly looking for the trendiest shot from the best perspective, leading to travel plans being made based on where one would get the best photos.

Artificial intelligence is changing the face of photography

Simplifying the art of capturing moments.

Artificial intelligence is everywhere, more so in a smartphone's camera. AI is being used to process images via apps, using machine learning to mimic skills most professional photographers would employ. For example, Adobe has already started using it to better cut subjects from images. Apps like Arsenal help newbies take the perfect shot by choosing the best camera settings for the scene, while Pisma.AI can convert any image into a work of art reminiscent of an artist's painting. In just a few short years, AI is transforming both the way we shoot photos and how we edit them, and could make the entire process a lot easier in the future. ■

gadgets

» GEAR WE WANT

GOPRO HERO 7 BLACK

Fade to Black.

$599.95 | SHOP.GOPRO.COM

GoPro's latest flagship camera might look a lot like its predecessors on paper, but the the new Hero 7 Black seems to have turned its attention from boosting picture quality to addressing customer feedback. Chief among its hotly requested features is a video stabilisation mode, dubbed HyperSmooth, which builds on former video stabilisation to allow you to shoot gimbal-level footage in 4K 60fps. GoPro is not shy about claiming this is "the best in-camera video stabilisation ever" and have naturally used the tech's kickbacks for bonus features like stabilised time lapse images. It's even added direct live streaming for all those influencers out there and there's a number of audio and microphone tweaks that'll help the new voice commands and give a more professional sound to videos. **JB**

BELKIN BOOST UP

There's a new smartwatch dock on the block.

$189.95 | WWW.BELKIN.COM/AU

The majority of smartwatches are, arguably, only just starting to offer enough essential features to justify charging them every day (at least for many users). And while part of this is because smartwatch batteries are not quite as long-lasting as we'd like, part of the blame is also due to the fact that you probably don't have a super convenient place to charge it. Enter Belkin Boost Up, the charging solution of any Apple affictionado's dreams. Slotting a smartphone wireless charger directly next to an Apple Watch one this faster 7.5W Qi Charging base keeps your devices upright and in range, in case you want to see the time or notifications while they charge. **JB**

TILE PRO AND MATE

Track all your things for longer.

MATE $39.95, PRO $59.95 | WWW.TILE.COM

Tile has added a pair of trackers to its lineup that address the finite lifespan of its predecessors by integrating a replaceable battery. The new Tile Pro and Tile Mate batteries are guaranteed for a year and the company will even send replacement CR2032s if you sign up for its Tile Premium subscription service. At either $40 per annum or $4 per month, Premium also includes smart alerts, additional sharing options, 30-day location history and an extended warranty. The IPX water resistance drops to IP55 (splashproof) from the IP68 (1.5m) rating on the earlier Style and Sport trackers, but the Pro gets a 90m range, and both new Tiles feature increased volume and smart speaker integration. **JB**

CYBERSHOES

VR's new kicks.

$275 | WWW.CYBERSHOES.IO

If you've ever used VR you'll know that the more of your body that is tracked, the more immersive the overall experience will be, so we were naturally pretty keen to check out these new VR slippers. Looking like the futuristic lovechild of a thong and some snowboard bindings, Cybershoes work with your desk chair to allow you to do everything from walking to fly-kicking in existing VR games. While Cybershoes were still just a funded Kickstarter at the time of writing, the team already had working prototypes that integrates with VR titles like *Skyrim* to offer an amazingly immersive experience. **JB**

GOOGLE HOME HUB

Home is where the Hub is.

$219 | STORE.GOOGLE.COM

In addition to releasing a pretty major overhaul to the Google Home app in October, the Alphabet owned company also introduced the first screened device to it's smart speaker range. The Google Home Hub's 7-inch display allows you to look at your calendar, play YouTube videos, get recipe instructions, see directions and automatically cycle through your favourite cloud-stored photo albums when you're not using it. While the screen adds a lot of functionality, it's arguably the AI that is the star of the show allowing you to search for photos from a specific time, location or even of a particular individual, and display these groupings as a custom album. **JB**

ELGATO THUNDERBOLT 3 MINI DOCK

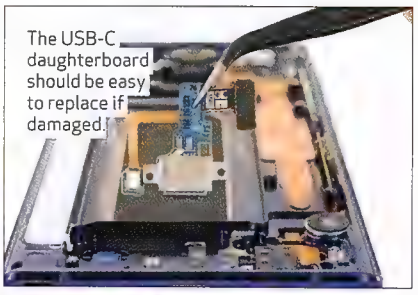
For Macbook Pro owners

USD$149 | ELGATO.COM

Corsair is certainly diversifying. Here's its first product under the Elgato brand, which it recently acquired and that covers peripherals for connectivity and streaming. This one is all about portability, hence its diminutive size (about the same size as a cigarette lighter), and fold out Thunderbolt 3 cable. Perfect to take out and about with your new MacBook Pro, or use at your desk if space is tight and your needs simple.

It includes a DP 1.2 output, HDMI 2.9, USB 3.1 Gen 1 and a Gigabit Ethernet port, and is compatible with macOS High Sierra 10.13 or later. This is what we'd call the bare minimum set of ports, but that's what this product is focussed on. Of course having a laptop with such essential ports built into it is what we actually prefer. **BM**

howit'sdone



Samsung Galaxy Note9

An improvement.

Samsung is at it again with the Galaxy Note9, right on schedule. Amid a brutal anti-Apple ad campaign, it's hoping a cool new S Pen is enough to carry the day. Could there be more waiting for us under the hood? We'll tear down to find out!

MAJOR TECH SPECS

- Notchless edge-to-edge 6.4-inch Super AMOLED display with 2960×1440 resolution (516 ppi)
- Octa-core Qualcomm Snapdragon 845, with 6GB/8GB RAM
- 4,000mAh battery
- 12MP OIS dual rear camera, with dual-aperture f/1.5–f/2.4 wide-angle and f/2.4 telephoto modules, plus 8MP selfie cam
- 128GB/512GB storage, extra 512GB available via microSD
- S Pen stylus with Bluetooth connectivity
- IP68 dust and water resistance rating

KEY FINDINGS

- The Note9 looks very similar to the Note8—and in principle, we're fine with that. So, what is new? Well, it's very slightly wider and shorter than the Note8, with an extra 0.1 inches of display, and it's a hair thicker at 8.8mm versus 8.6mm. In an increasingly rare (but welcome) move, Samsung has kept the analog headphone jack. Another subtle (but good) change: The fingerprint sensor has packed its things and moved to a happier location, south of the rear camera.
- We'd like to hit the ground running, but the back panel adhesive is pretty OP. Our usual strategy of heat, suction, and careful slicing does the trick eventually. The new fingerprint sensor location is welcome—the flex cable is less vulnerable to accidental slicing and dicing. That said, it's still too short.
- The battery's still glued down in a miserable sticky well—but the Note8 didn't blow up, so the design is justified, eh Samsung? The battery weighs in at a ludicrous 15.4Wh, eschewing the cautious 12.71Wh Note8 battery, and eclipsing the Note7 (13.48Wh) and iPhone X (a "mere" 10.35Wh).
- The motherboard has absorbed yesteryear's daughterboard, leaving a modular USB-C port (with hanger-on mic) ripe for the picking. Samsung continues to provide sanctuary for the now endangered headphone jack, while saddling it with a super-thin spring-contact-connected cable. The heat pipe has significantly more surface area than prior generations.
- We couldn't find a non-destructive way to crack open the S Pen, so we swapped in the ultrasonic blaster cutter! We conjecture that the S Pen charges via the sensing coils near its tip. We found a gray pad near where the coils reside when the stylus is stowed—possibly an inductive charging pad.
- The Note9 isn't a radical redesign, but it's fresh enough to keep our teardown engineers happy. The Note line tends to evolve slowly—bigger motherboard, a different pen, nothing major—except for a battery that exploded in size.
- Repairability score: 4 out of 10 (10 is easiest to repair). This Note's components are more modular than ever, thanks to subtle changes to the USB-C hardware, headphone jack, and the S Pen dock's flex cable. The only screws are standard Phillips ones. You can replace the battery if determined—two stubborn glue barriers make it difficult. To service any component you must painstakingly unglue (then reglue) the glass rear panel. Display repairs require replacing the entire chassis or tediously separating the gluey cracked glass. ■

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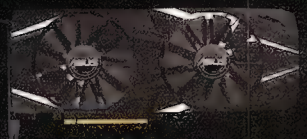

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High static pressure, low noise, and 0dB fan-stop mode

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50% more heatsink surface area compared to last gen

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Reinforces the graphics card to prevent PCB flex and trace damage

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WHEN TWO BECOME ONE

I have just received my monthly magazine and discovered it has changed to *APC*, although the magazine seems to be good the *APC* website is very sparse compared to the *PC & Tech Authority* website. Will the *PC & Tech Authority* website be incorporated into the *APC* website as it provides a lot of great information for readers to use.

Also, many years ago before I subscribed to *PC & Tech Authority* I looked at *APC* and decided that *PC & Tech Authority* suited my needs, I hope that aspects of *PC & Tech Authority* are incorporated into the *APC* magazine in the near future.

Barrie Fuss

Ben Mansill replies: *We certainly will be incorporating some of the unique parts of PCTA here, like System News and Market Watch for now, and quite a few of our favourite writers are onboard with APC as well. Future Publishing (APC's publisher) is focussed on* **techradar.com** *for online PC and technology content, as well as* **pcgamer.com** *for gaming and* **tomshardware.com** *and* **anandtech.com** *for deep PC coverage.*

UPGRADING

I have decided to go ahead with a new subscription based on the absolutely fantastic quality this magazine brings along. All the subjects were covered that needed covering. From reinstalling Windows to the new Apple Mac Pro's edition review. I am currently using the top of the line MacBook Pro, and for the cost of a small car it was worth it!

Every time there is something new, and six cores is better than four and 32GB DDR4 is better than 16 GB DDR3 – *APC* just got better too joining in with *PC & Tech Authority*!

Mark

WITH THANKS

Thank you Dan for your stewardship of *APC*. I have enjoyed the changes you have introduced; broadening the platforms and technologies that *APC* shows interest in, changing layouts and so on. For the price of a coffee and muffin each month you have produced a fine magazine. My surprise and joy is that *APC* has lasted this long in paper form and yet there is no substitute for dragging out a magazine in a plane, waiting for a bus or just enjoying a break. Thanks and all the best for you next adventure.

Paul Maconochie

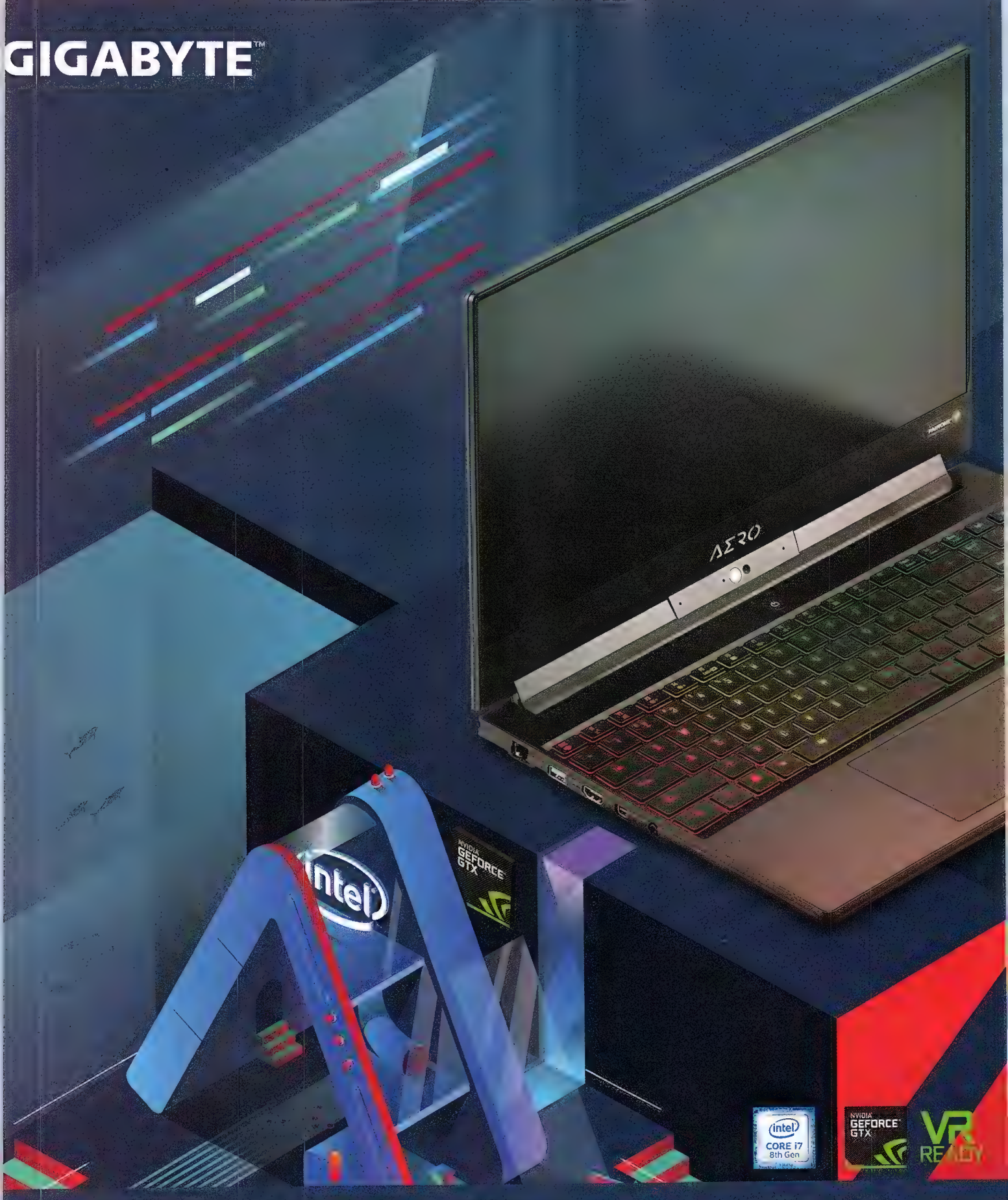
Dan Gardiner replies: *Thanks for the kind (and humbling) words Paul – as I mentioned in my last editorial, it's been a genuine pleasure and privilege to oversee APC for the last 70 or so issues.*

We've still got some big plans for the mag going ahead, too – and I'll be hovering around in the background for a while, so don't be surprised if you see my byline cropping up every now and again. Thanks again for your support – and please feel free to reach out to the new editor Ben Mansill in future if you've got anything to say about the mag. We always love to get feedback – good or bad – from our readers. ■

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.



5mm Thin Bezel Design: Experience True Visual Immersion

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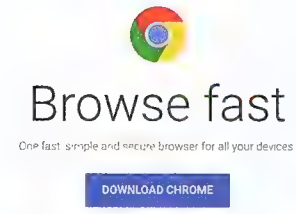
» SHAUN PRESCOTT DIGS INTO THE BIG TECH ISSUES AFFECTING CONSUMERS.



Google Chrome 69's log-in debacle was an example of dark pattern design

Huge tech companies will pull all manner of tricks to get your data, writes Shaun Prescott.

Google's Chrome 69 update caused quite a kerfuffle when it rolled out in September, for one fairly innocuous-sounding reason. In theory, the company had intended to streamline the log-in process across its various sites, including Gmail and YouTube. While previously you'd need to sign into each of these entities individually, 69 made it so a single log-in via any of these channels would sign you into the associated Google account on the browser level. This means that once you've signed into one account, you'd be signing into Chrome with a Chrome account.

According to Google Chrome engineer and manager Adrienne Porter Felt, these changes were made "to prevent surprises in a shared device scenario". She continued: "In the past, people would sometimes sign out of the content area and think that meant they were no longer signed into Chrome, which could cause problems on a shared device." That sounds sensible in theory, but it neglects one user group: those who do not want to be signed into Chrome. With Chrome 69, Google made signing into the browser mandatory for anyone signing into Gmail or YouTube on any device.

Worse still, a new option to "sync" account data between signed-in devices appeared purposely vague: users new to the concept of logging into Chrome, couldn't tell whether their data was syncing, or whether they were being offered to have their data synced. It seemed deliberately manipulative, according to cryptographer and John Hopkins University professor Matthew Green.

"In short, Google has transformed the question of consenting to data upload from something affirmative that I actually had to put effort into – entering my Google credentials and signing into Chrome – into something I can now do with a single accidental click," Green wrote in a blogpost on the matter. "Whether intentional or not, it has the effect of making it easy for people to activate sync without knowing it, or to think they're already syncing and thus there's no additional cost to increasing Google's access to their data."

After widespread condemnation for the move, Google allowed users to opt out of auto-browser log-in with the October release of Chrome 70 (it's still "on" by default). Still, Google's quiet attempt to corral its users into acquiring a Chrome account – not to mention the obscure "syncing" functionality – is an example of "dark pattern" user interface design. In other words, UI design that subverts its own established patterns in order to trick the user into opting into something.

Dark pattern design is a common strategy for dodgy software installers. For example: you're prompted to tick a box to opt-in to the terms and agreements, but then you're required to tick a box in order to opt-out of some third-party software demo being installed. These tactics were once the sole province of spam, viruses and hacks, but the likes of Facebook and Google are adopting the practice. "Data is the new oil," is a widely repeated soundbite in 2018. And whether that's true or not, tech companies are getting more and more desperate for it. Be vigilant. ■

END USER

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apc RECOMMENDS

ROUTER

$399 | AU.NORTON.COM

Norton Core

This good-looking router secures everything on your network. But while web-browsing range is impressive, it's poor for online gaming.

Norton has intruded into the wireless router space like one of the cyber-nasties that it's traditionally known for keeping away. But its presence is a breath of fresh air: not just because it has thumbed its nose at the history of router dogma by forcing all configurations to go through a mobile app instead of fiddly browser settings, but because it looks so dang good. The geodesic dome looks more like something you'd want to show off than hide and, for some, this alone will be reason to buy it.

Setting it up resembles the process we've come to expect with wireless mesh networks in that the mobile app sets the password, automatically updates the firmware and then everything just works straight away. Norton has even combined its 2.4GHz and 5GHz bands into one network which dynamically adjusts itself as you move around your home, ensuring that you've always got the fastest connection speed.

Its range is impressive too. Using Ookla's SpeedTest, an iPad Pro and a solid Telstra cable connection (115/5Mbps) it maintained a full wireless connection speed up close and only dropped to 50 per cent when one floor up (as with other routers). It also managed a usable 30Mbps two floors up which no other rival has managed without using an extender.

But it's not perfect. When streaming more than three video streams it could stutter a little. This is no deal breaker but its online gaming performance will be for many: no matter how many settings we adjusted, we constantly suffered horrendous lag spikes.

If you're not a gamer (or have many kids streaming video) it's still worth your attention though. Coming from Norton it of course oozes security features with everything on your LAN being protected at a network level. This includes all IoT devices like webcams, doorbells, NAS boxes and TVs by using Norton Core Security Plus software that self-updates in real-time. A one-year subscription is included and will cover 10 other mobile devices outside your network. At $18 per month thereafter it's certainly not cheap but at least it's offset by not needing to buy separate Internet Security software for your devices. As a rough yardstick to compare, Norton currently sells its Security Premium software for $99.95 for five devices.

The mobile app lets you configure every typical router setting although adding ranges for Port Forwarding can't be done. However, it's the device control and advanced Parent Controls that steal the show. You can easily see every device that's attached to the network and control access to them. You can also assign people to different devices and control how many hours they can access the internet each day for plus set a bed-time cut-off. There's also category-based content blocking: while this is far from infallible, you are notified if a cheeky teenager triggers one of the successfully-blocked sites so you'll still know if they're up to mischief.

At $399 it's not cheap and the ongoing subscription will add to the expense. However, if you're not a gamer and are worried about being hacked on any of your domestic devices, in terms of looks, features and performance, this is one of the best wireless routers you can buy. ■ **Nick Ross**

Verdict

Decent range and performance, but it struggles with multiple video streams.

★★★★½

CAMERA

$320 | INSTA360.COM

Insta360 One

High-quality 360° videos.

This camera is a small lozenge with 4K, 180° cameras on each side, combining to create 360° footage. The device feels solidly made, and operating it standalone is relatively straightforward – one press of the single button to turn it on, another press to take a photo, a double-press to begin video recording, and three presses to start 120fps 'bullet time' recording.

Connecting it to an iOS device reveals the Insta360 One's true power, though. The integrated Lightning connector is tidy, and the app works well, bar a few translational mistakes. From the app, you can start and stop 360° recording and set shutter speeds and ISO. In relatively dim light, footage is impressively crisp and clear. In good light our videos were outstanding.

It's the app that really makes the Insta360 as good as it is, thanks to its raw power coupled with top-notch ease of use. You can use the app to generate spherical 360° videos, but your audience needs access to a device capable of virtual reality playback (iOS isn't natively capable, but the YouTube app is).

However, you can opt for the app's FixFrame mode, which flattens footage to 16:9, 9:16 or 1:1. You can add tracking points to your footage, swinging the virtual camera around the world, or have the app automatically add a tracking point, keeping your subject in the frame. It works brilliantly well and elevates the Insta360 One above the status of one-trick pony.

■ **Dave Stevenson**

Verdict

Capable of excellent results thanks in no small part to its outstanding app.

★★★★☆

SSD

$189 (250GB), $269 (500GB), $569 (1TB
SEAGATE.COM

Seagate Fast SSD 1TB

Premium speed, premium price.

When you put 'Fast' in your product name, you'd better hope it lives up to that promise. Thankfully, there are no worries here – this is one of the zippiest SSDs we've ever reviewed.

Over USB-C (on a Mac that supports USB 3.1 Gen 2), the drive delivered mean average transfer rates of 447.2MB/sec when reading and 411.7MB/sec when writing. That puts it on par with the fastest single-drive portable SSD we've tested – CalDigit's Tuff – with the bonus of being notably smaller. We also observed maximum read and write speeds of 537.4MB/sec and 502.6MB/sec, which are in line with Seagate's claims.

If your Mac or PC doesn't have USB-C, fear not. Transfer rates over USB-A (limited to USB 3.1 Gen 1's 5Gbps bandwidth) matched our expectations, based on other drives we've tested.

The drive looks lovely, with a Mac-like grey and silver colourway. Larger than some rivals, handling it brought back memories of floppy disks. It's light enough to slip in a pocket, but the Verbatim Store 'n' Go drive from beats it on both weight and volume – though in terms of bulk there's really little in it and the Seagate Fast SSD is extremely portable, and in my opinion is a particularly good looking device, too.

Yes, it's still fairly expensive for an SSD, but you get USB 3.1 Gen 2 speeds here, if your Mac can handle that. If you want speedy storage in a stylish and svelte form, the Fast SSD delivers in spades. ■

Alex Blake

Verdict

A speedy and stylish drive, but the cost may put you off.

★★★★☆

"It's a 15.6-inch external display, with a FullHD 1080p pixel grid that connects via a single USB-C interface to supply both power and video."

HIGH-RESOLUTION DISPLAY

$249 | WWW.AOC.COM

AOC I1601FWUX

IPS screen and USB-C; is this the perfect portable LCD panel?

Portability and plenty of screen real estate don't normally see eye to eye. However, a recent development is enabling those two ancient foes to become a little more pally. We speak, of course, of USB-C, in all its single-port, multi-function glory.

It's an enabler thanks to three key properties. First is loads of bandwidth, which is essential for driving high-resolution displays. Second is support for DisplayPort alternate mode, and thus the ability to function as a video port without the need for special drivers. Third is the ability to supply much higher power output. USB-C maxes out at 5A and 20V, and thus fully 100 watts. Not every USB-C port will necessarily deliver the full 100 watts, but broadly speaking, if your PC or laptop has a USB-C port, it will be able to supply significant power to any attached peripheral. Put that all together and you have the perfect combination for attaching and driving a compact external display via a single port.

Enter, therefore, the AOC I1601FWUX. It's a 15.6-inch external display, with a FullHD 1080p pixel grid that connects via a single USB-C interface to supply both power and video. It's an appealing idea. The unit itself is compact and light, and broadly comparable to carrying a tablet. It doesn't require charging, although it will, obviously, represent a pretty significant drain on a laptop's battery pack if used away from the grid.

As for the primary speeds and feeds, the panel itself is IPS. AOC doesn't get too specific, but it's only claimed to support 262,000 colors, so we're likely talking about a low-end 6-bit-per-channel panel, which is probably fine for this type of application.

Elsewhere, AOC claims 5ms response times and maximum 220cd/m2 brightness; AOC doesn't quote a contrast ratio. Other notable features include a magnetic screen cover that doubles as a stand, plus a single button that provides access to the on-screen menu. The latter makes for a rather laborious configuration process, because it involves pressing the button to cycle through options, and then waiting several seconds for your chosen option to activate.

The actual performance of the display, however, is a little less so. Given the brightness rating, and the fact that broad compatibility puts a practical limit on how bright this type of display can reasonably be, we weren't expecting fireworks. But the overall impact of AOC's portable panel remains rather underwhelming. Dingy colors with a slightly green-tinged overall balance probably sums it up. When you consider the high quality of LCD panels that are now standard in even the most mundane Android tablets, it's a little difficult to stomach this quality of panel. That said, it's not worse than you typically get in many middle-market laptop PCs.

That's a pity, because the concept and execution is otherwise pretty appealing. 1080p makes for a welcome slice of extra screen real estate, and is plenty for web browsing, running a mail client, viewing documents, and all that stuff. It's a very handy little gadget to have with you on vacation or travelling on work trips.

The I1601FWUX will do all those things and objectively get the job done well enough. But you'd enjoy doing all that a lot more and we'd find it easier to recommend if the LCD panel had a tad more visual pop. Even taking into account the relatively modest $249 entry fee, most users will probably be expecting just a little bit more. ■ **Jeremy Laird**

Verdict

Compact; single-cable connectivity; decent 1080p resolution. Disappointing image quality.

"BenQ's new gaming monitor combines all of the above, and more. In fact, it throws USB-C into the mix, along with a 32-inch diagonal LCD panel, and a gaming-friendly quad-HD 2560x1440 native resolution."

apc RECOMMENDS

MONITOR

$799 | WWW.BENQ.COM

BenQ EX3203R

BenQ brings HDR lite to the desktop.

Struggling to keep up with the latest must-have features for gaming monitors, such as 144Hz refresh rates, adaptive sync, curved panels, and low input lag modes? Then prepare to be even more baffled. HDR, or High Dynamic Range, visuals have arrived, and represent perhaps the most complex and confusing technology to yet hit the monitor market.

BenQ's new gaming monitor combines all of the above, and more. In fact, it throws USB-C into the mix, along with a 32-inch diagonal LCD panel, and a gaming-friendly quad-HD 2560x1440 native resolution. On paper, the EX3203R is killer. In practice? It's more complicated.

For starters, not all HDR displays are equal. In fact, good luck finding two that are entirely comparable. Not only are there multiple bodies setting standards, but even within a single standard-setting authority, you'll typically find a tiered hierarchy of HDR certification. The EX3203R is a case in point. It's one of the very first monitors to be awarded VESA's DisplayHDR 400 standard. So, there's no doubt about its HDR credibility. Right?

Not exactly. DisplayHDR 400 is VESA's entry point into HDR. It only requires a peak brightness of 400cd/m2. Many would argue the full impact of HDR only arrives at 1,000cd/m2. DisplayHDR 400 also doesn't dictate local dimming capability, and makes less stringent demands for color reproduction; BenQ says the EX3203R is good for 90 percent coverage of the DCI-P3 profile. So, DisplayHDR 400 is probably best viewed as HDR lite.

The EX3203R has further on-paper shortcomings. The 32-inch panel uses VA tech. That's great for contrast and eye-popping colors, so makes for a good fit with HDR. But VA is also the slowest of the major LCD panel technologies (the others being TN and IPS) when it comes to pixel response. Not so great for gaming, then.

But if the EX3203R presents a complex theoretical proposition, how does it stack up in practice? The design is restrained for a monitor aimed at least partly at the gaming market, but with slim bezels on three sides and a sleek silver stand, the initial impression is of money well spent.

Odds are, you'll like the look of this from a gaming perspective, too. The colors are seriously punchy, and while 400cd/m2 may be no great shakes by HDR standards, it's more than bright enough by conventional metrics. Likewise, the EX3203R's panel is rated at 3,000:1 for static contrast capability, and it looks every bit as good as that. The VA panel's relatively subtle gentle curve also makes for a nicely immersive experience.

It's worth noting that HDR remains problematical in terms of everything from ensuring it's enabled to the mixed results you get when it is. Enabling HDR globally in Windows, for instance, makes the desktop look very dull. And as a general-purpose monitor, the EX3203R's GPU-friendly 2560x1440 native resolution results in fairly fat and ugly pixels on the desktop. This is no high-DPI display.

The VA panel also prevents the EX3203R from being at the cutting edge in terms of pixel response performance. However, inverse ghosting is not a major issue, and the 144Hz refresh delivers a fantastically smooth experience, provided you have a powerful and probably pricey graphics card. The EX3203R is not entirely free from flaws, and it's not great all around, but it is a pretty compelling gaming companion.

Jeremy Laird

Verdict

Mega feature set; punchy visuals; good gaming fit. Arguably not true HDR; not a great multi-purpose panel.

★★★★☆

34-INCH QLED DISPLAY

$1,599 | WWW.SAMSUNG.COM/AU

Samsung LC34J791

Ditch your KVM switch with this new curvy ultrawide.

Pitched as the world's first 'Thunderbolt 3' display, this 34-inch quantum-dot LED (QLED) monitor begs one immediate question: what the hell is a Thunderbolt 3 display, and why would you want one? Well, as part of its spec, Thunderbolt 3 includes a DisplayPort 1.2 connection, which lets you utilise basically any video standard you like – be that HDMI, DVI, VGA or DisplayPort itself. Thunderbolt 3 also has plenty of leftover bandwidth in its 40Gbps of total bandwidth to allow for lots of other devices to connect alongside that video stream, so you can get your USB peripherals, storage devices, audio and so on all through the one cable.

What this means is that it's very quick and easy to plug any kind of device into the LC34J791 and have it work with all your attached accessories. Moreover, it also means you can use it as a pseudo KVM switch – plug your keyboard and mouse directly into the back of the display and they'll work with whatever display device is currently using the screen, whether that's the gaming PC snuggling under your desk, or your Thunderbolt 3-equipped ultrabook that you've just brought home from work. The display can even provide power to, and recharge, laptops up to a beefy 85W while they're plugged in and in use.

The LC34J791 doesn't just have Thunderbolt for video input – there's also standard HDMI and DisplayPort sockets hidden under a rear cover.

While this isn't specifically a designer's monitor – there are no presets for Adobe RGB or other design-standard colour profiles, for example – out of the box, its colour settings are tuned almost bang-on the 6500K ideal, meaning it'll do a fine job for anyone who wants to do a bit of video or photo editing for web or other digital use, and its 3,440 x 1,440-pixel resolution means there's masses of virtual real estate upon which to spread out your digital canvases and toolboxes.

The display also delivers fantastically smooth and consistent images thanks to very even backlighting, and that underlying metallic quantum dot means colours are very natural on the Standard colour profile – and there're a handful of additional preset modes for tasks like gaming.

Speaking of gaming, Samsung's also thrown in AMD FreeSync support to work alongside the display's native 100Hz refresh rate, meaning it's a reasonably-capable gaming screen too. The response time can also be adjusted slightly, with menu options to select from Normal, Fast or Fastest modes – which we found essential to change when playing pacy first-person online titles.

The LC34J791 does have some drawbacks, however. You'll pay a premium, for one, with the combination of QLED and Thunderbolt 3 costing $600 more than Samsung's similar LED-based 34-inch ultrawide. This picture quality can have some shortfalls too. For example, at higher brightness settings, certain colours – like bright blues – have a tendency to expose the display's QLED structure, producing very faint dark horizontal lines every centimetre or so down the screen's entire height. Additionally, finding settings that gave us an adequate amount of detail in blacks to play darkly-lit games (while also remaining reasonably vibrant) also took some tweaking – although it can certainly be done. Still, this definitely wouldn't be our first choice if you're looking for a display for gaming...

Dan Gardiner

Verdict

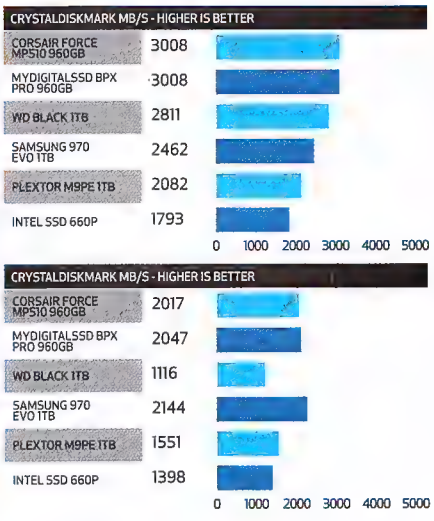
A flexible screen with smooth and natural colours. Lots of real estate and cutting-edge connectivity features.

★★★★☆

SSD

USD$249.99 (60GB), USD$69.99 (240GB), USD$129.99USD 480GB | WWW.CORSAIR.COM

LABS BENCHMARK RESULTS


CRYSTALDISKMARK MB/S - HIGHER IS BETTER
CORSAIR FORCE MP510 960GB 3008
MYDIGITALSSD BPX PRO 960GB 3008
WD BLACK 1TB 2811
SAMSUNG 970 EVO 1TB 2462
PLEXTOR M9PE 1TB 2082
INTEL SSD 660P 1793
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CRYSTALDISKMARK MB/S - HIGHER IS BETTER
CORSAIR FORCE MP510 960GB 2017
MYDIGITALSSD BPX PRO 960GB 2047
WD BLACK 1TB 1116
SAMSUNG 970 EVO 1TB 2144
PLEXTOR M9PE 1TB 1551
INTEL SSD 660P 1398
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Corsair Force MP510

A force to be reckoned with.

Corsair's Force series SSD line has a strong lineage tracing back to 2010. Having gone through multiple controllers, NAND types, and recently evolving from strictly SATA to the PCIe interface with multiple form factors, Corsair's decisions and products have been on the leading-edge year after year, getting better every step of the way.

Today, that history is what drives the company's latest SSD, the Force MP510. With a blacked-out PCB, Phison's E12 controller, and Toshiba's BiCS3 TLC NAND flash, the MP510 looks good--and brings the performance to match. The drive is flat-out fast, rated up to 3,480/3,000MB/s of read/write throughput. And to top things off, it comes with a longer warranty, greater endurance, and cheaper pricing than its predecessor.

Corsair's Force MP510 is a refresh of the Force MP500 series that brings with it some much-welcomed improvements. Released back at the beginning of February 2017, the MP500 featured Phison's E7 controller and Toshiba's 15nm MLC NAND flash. Together, this rather popular combination delivered good performance, but Corsair's premium pricing kept it out of the hands of many and left it rather uncompetitive. The company is looking to change that with the new MP510.

Continuing its relationship with Phison and Toshiba, Corsair has replaced the MP500's components with the latest offerings from those two companies. It utilises Toshiba's 64L 3D TLC NAND flash and Phison's latest (and highest performance) SSD controller, the PS5012-E12. Many technologies are built into this controller, including StrongECC, SmartRefesh, and SmartFlush.

The Corsair Force MP510 features a five-year warranty, an appreciated upgrade from the previous-gen MP500's three-year warranty. The MP510 smashes even the Samsung 970 Pro's endurance figures. But while the Corsair drive is essentially the same drive internally as the MyDigitalSSD BPX Pro, Corsair rates its endurance figures a bit higher. At 1.7PB for the 960GB model, the endurance is almost three times that of the Samsung 970 EVO and the WD Black. To put it into perspective, the MP510's endurance rating at over eight times higher than the Intel SSD 660p!

Corsair's Force MP510 nearly matches the BPX Pro in Crystal Disk Mark. It tied for second place in sequential reads and landed in first place in sequential writes at QD32. When backing down to QD1, it ranked third, just behind the BPX Pro and Samsung 970 EVO, but then again came in second during sequential writes.

Random performance of 50/169MB/s nearly matches the BPX Pro again, but the MP510 ranked 4th in performance overall. From QD1-8, the MP510 delivers respectable results. It has pool-leading write performance, but read performance is just average.

Corsair revitalises its Force MP500 series with an infusion of the latest components. The Force is indeed strong with this one. Utilising Phison's new E12 controller and Toshiba's BiCS3 64L TLC NAND flash, the Force MP510 is a much-welcomed successor that brings more value to the table and the best endurance rating from any consumer SSD we have seen yet. With over 1.7PB (yes, that's nearly two petabytes of endurance), the MP510 is a workhorse that's designed to keep on going and going.

Sean Webster

Verdict

Better value than its predecessor along with better endurance ratings than other consumer flash-based SSDs.

Path Finder 8

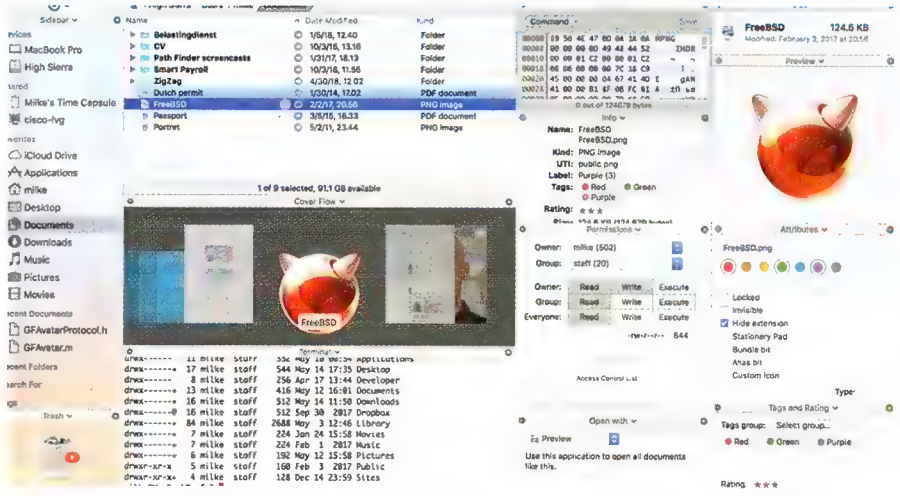
It's Finder, but not as you know it.

USD$40 | COCOATECH.COM

The venerable Path Finder could be considered the senior citizen of Finder alternatives. But it also remains the most powerful, since the software can be configured to completely quit the Finder, act as the default Terminal, and even perform basic text or image editing tasks directly.

Version 8 introduces new ways to view and work with files and folders. Modules allow you to completely tailor the look of the Path Finder browser to your needs by dragging and dropping icons onto the app window. The concept isn't new, but the new version is very flexible – modules can now be placed anywhere you like, with control over the look and functionality of each.

The current lineup boasts 21 modules for viewing attributes, Cover Flow, an image browser, recent documents or folders, an additional



sidebar, or the ability to create a drop zone for opening files with another application. That helps Path Finder 8 stand apart from the competition.

There are a few caveats: the sidebar can no longer be temporarily collapsed when not needed, and you can't save and restore window layouts. **JR Bookwalter** ■

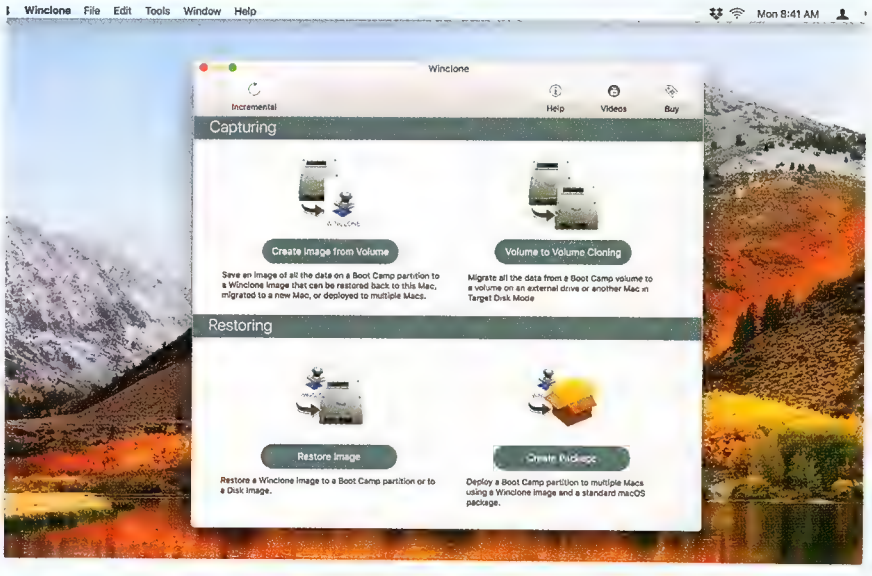
Winclone 7

Safeguard your Windows partitions

USD$47.99 | TWOCANOES.COM

Many of us need to use Windows from time to time.For that, Boot Camp is great, allowing you to partition your Mac's startup drive and install Windows on one partition, leaving macOS on the other. To run Windows on your Mac, all you do is boot from the Boot Camp partition. It's probably the simplest way to run Windows on your Mac.

The issue with Boot Camp is there's no easy way to clone, migrate, or restore a partition. That's where Winclone 7 comes in. It creates an image of your Boot Camp partition, including the Windows installation and all files and folders on it. Create the clone on an external drive and you have a backup of your installation – handy if you're about to update Windows or do anything that could change the installation and potentially cause a problem. It also makes it easy to move the whole Boot Camp partition to a different Mac.

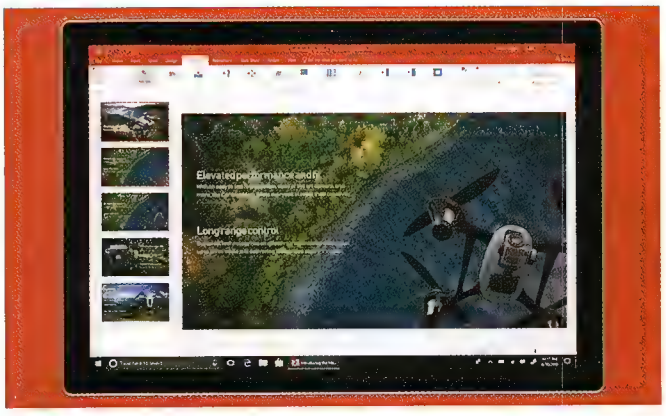


Version 7 now allows you to incrementally update cloned partitions, which reduces the time cloning takes. It's easy to set up and use. You may regard its price tag as a little high, but if your work needs Boot Camp, it's a price worth paying. **Kenny Hemphill** ■

software

» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE



Microsoft Office 2019

For the Office 365 holdouts.

$199 | PRODUCTS.OFFICE.COM

Microsoft Office doesn't need much of an introduction, and Office 2019 is the latest and greatest version of the suite. Office 2019 won't receive any feature improvements over time, apart from security fixes and bug-squashing updates, but it's yours for a one off payment. Office 365, meanwhile, gets new features regularly – all of the new stuff in Office 2019 is already available to Office 365 users -- but you pay ongoing subscription fees. Word, Excel and PowerPoint still offer a level of depth and control that you don't get from the likes of Google Docs or open source office alternatives and if you can live with the suite tied to a single computer then Office 2019 is still worth a look.

Word's biggest updates include improved translation, text-to-speech, and text spacing options, as well as better support for stylus pens and digital scribbles within your documents. There's also new is a Focus mode that strips away the surrounding distractions when you need to just read through something on-screen (which will be similar to the reading mode in most browsers).

Over in Excel, you've got a smattering of new functions and chart types and you can now drop 3D models into your spreadsheets and view them from all angles. There's also new integrated forecasting based on existing data, better pivot tables and cross-tabulation of data, built-in 3D mapping of data and the addition of a Power Query plugin for piping in more data from other sources.

Powerpoint gets some new tricks in Office 2019, including support for advancing slides with Bluetooth pens, a new zoom interface for jumping between slides, and a cool morph transition. It might not be as lean as some of its newer rivals (like Google Slides) but it's hard to beat in terms of overall capabilities.

Outlook's email component now features a new Focused inbox that'll prioritise what it thinks are you most important emails. There's also a feature that'll read your emails aloud and a much better time zone integration across the calendar. **David Nield** ■

CyberLink PhotoDirector 10

MORE ADVANCED AND MORE FUN.

$110 | WWW.CYBERLINK.COM

CyberLink PhotoDirector 10 isn't hugely different to its predecessor – but the few new features it does offer are well designed and largely come as a result of user feedback.

Tethered shooting is the first major novelty, enabling you to capture photos from a connected camera directly from within the editing software – a real timesaver for shooting stop-motion animation. There's also improved layer editing, allowing you to create layer groups, clipping masks, and add new empty layers, which puts it more in line with top-end photo editing suites like PhotoShop.

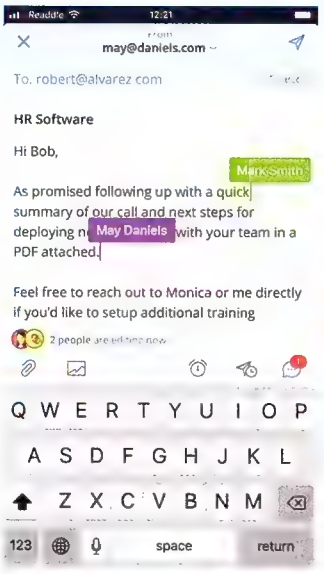
The introduced AI Style Transfer tool uses deep learning to recreate the style of a particular drawing or painting, and apply it to your photo using the same techniques, just as an artist might.

Each effect is customisable and lets you choose whether to use the photo's original colours or use those from the style template. CyberLink PhotoDirector 10 isn't a powerful enough to replace something like Photoshop, but for hobbyists that just want to improve personal photos it has a much flatter learning curve and will do the vast majority of things you want. **Cat Ellis** ■

Spark

A smart, sophisticated email client.

FREE | SPARKMAILAPP.COM


may@daniels.com
To. robert@alvarez.com
HR Software
Hi Bob,
Mark Smith
As promised following up with a quick summary of our call and next steps for deploying n
May Daniels
with your team in a PDF attached.
Feel free to reach out to Monica or me directly if you'd like to setup additional training
2 people are editing now
Q W E R T Y U I O P
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123
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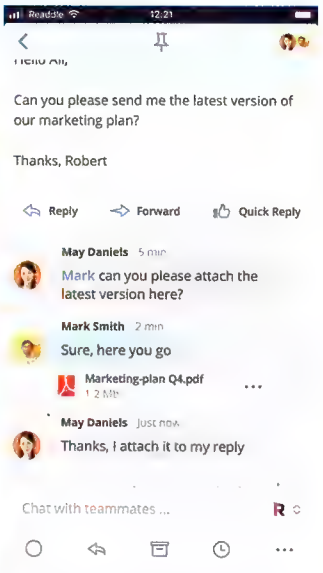

Can you please send me the latest version of our marketing plan?
Thanks, Robert
Reply
Forward
Quick Reply
May Daniels
Mark can you please attach the latest version here?
Mark Smith 2 min
Sure, here you go
Marketing-plan Q4.pdf
May Daniels Just now
Thanks, I attach it to my reply
Chat with teammates ...

There's no shortage of email clients vying for space on your iPhone or iPad's home screen, so why should you be bothered about another? Well, for one thing Spark is more than just an email client. Sure, it allows you to send and receive email from any account, and to file it, flag it, or even ignore it if that's what you want to do. But Spark also merges features from collaborative tools such as Slack and Microsoft Teams. Its premise is that email is still at the centre of most of our working lives, so why not build a tool around that, rather than use something different?

The result is an email client, available on the Mac as well as iOS, that allows you to share drafts with colleagues and chat to them right inside the app. Alternatively, you can work together to write drafts. Email messages can be shared as web addresses and viewed by anyone with the link.

Also new in Spark is integration with a host of third-party apps and services, including Reminders, Things, Evernote, OneDrive, Google Drive, iCloud Drive and Dropbox. That integration makes it very straightforward to turn email messages into notes or to-do list items.

Spark doesn't skip on the features you'd expect from a modern email client, either. Messages are siloed by default into what Spark calls 'buckets', promoting the most important messages and keeping newsletters out of the way in their own bucket, for example. By default, pinned messages are displayed at the top of the screen, with the most recent three pinned messages shown. However, if you're like us and are somewhat haphazard in the way you use pinned messages, you can very easily change this behaviour so that they're not given prominence.

Messages can be snoozed so that they pop up again later, and the quick reply feature allows you to respond with an emoji. Built-in widgets let you see a list of emails you recently opened, reminders, and a calendar – if you use a Gmail account, for example, it pulls in your Google calendar.

Spark is very customisable, something that's important in a tool that wants to be at the centre of your working life. You can change the options for the length of time messages snooze, change what swiping gestures do, and change how widgets are displayed.

It's also very smart – the first time we composed a draft, it displayed email signatures we'd used previously in other clients and asked which one we wanted to apply. We also liked the option to add a reminder to a draft that didn't receive a reply within a set period.

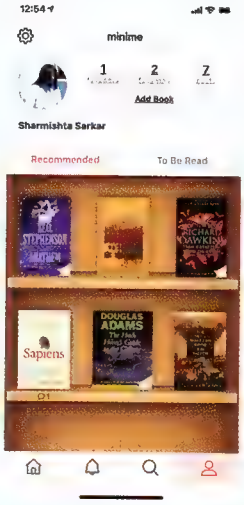
Search – a crucial email feature for most of us – is pretty good, too. It fooled us at first, however, only suggesting names and email addresses in results. It was only when we pressed Return on the keyboard that it delivered results with the search term in the subject line or body. **Kenny Hemphill**

Inky

Instagram-like book recommendation feed.

FREE | INKYBOOKCLUB.COM

Goodreads was, well, good while it lasted, then Amazon came along and changed the landscape. So the next time you want a book recommendation, you could turn to Inky. This brand-new app isn't as polished as, say, Reco, but the clean interface makes it easy to use, although the developers are constantly working on improving Inky. The app offers an easy way to keep tabs on your 'to read' list alongside books you've read and would recommend. You'll need to sign up to use Inky, after which you're presented with a list of users you can follow, although the Inky community is still rather small. Then there are two bookshelves to fill – books you've read already and recommend and your 'to read' list. Adding books to your shelf is easy: the search bar is quick and you just need to tap to add. You can choose to include your own review for your recommendations, and you can add brand-new publications to your 'to read' list by adding the title manually. The app only offers new recommendations from people you follow, but you can visit user profiles to check their full list if you want more variety. **Sharmishta Sarkar** ■



Elevate - Brain Training

An app that could make you even smarter.

FREE WITH IAP | ELEVATEAPP.COM

Although video games were a staple of my youth, I have little interest in them as an adult. Most are overly complicated compared to the classics, and cause family stress as kids hound parents for virtual currency to feed their latest addiction.

While not technically a video game, Elevate is the cure for those suffering from Fortnite fatigue. Using playful graphics and a barrage of brain games, this app challenges players to hone their skills and become a better, more intelligent person every time they use it.

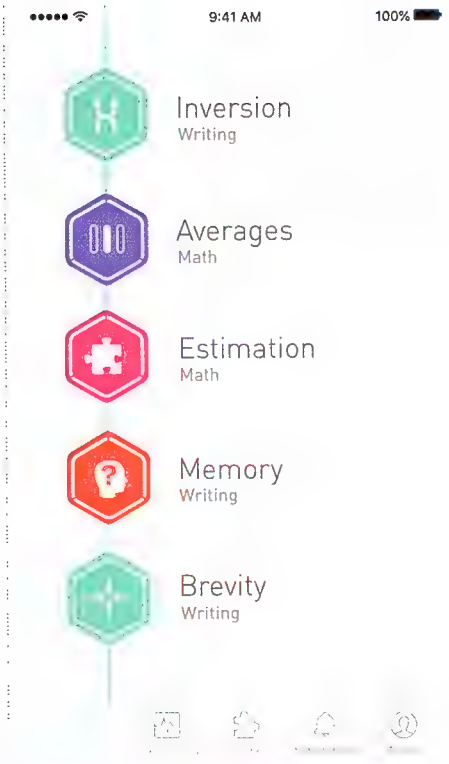
Every day, Elevate presents a handful of mental workouts designed to sharpen your mind. Exercises are tailored to the user, based upon your answers to a pre-signup introductory quiz. The app was smart enough to identify strengths at reading and writing, and picked up that math is our Kryptonite.

The app is comprised of more than 35 games, each carefully designed to tickle a particular cognitive skill like comprehension, precision, memory, and focus. Aside from five daily challenges, players can bone up with individual writing, speaking, reading, or math activities.

Like most games, you unlock achievements as you go, and Elevate ranks activity and scores as motivation to keep going. There are also study materials to stay sharp in between, but you'll need to complete five training sessions before they're unlocked.

Graphics and sound are impressive, helping to keep you engaged. The app is responsive overall, even when action becomes fast-paced. Despite being rated 4+, Elevate is best suited for teens and up, since most games assume players have a strong grasp of English grammar and vocabulary.

On the flip side, many user interface typefaces lack contrast or are occasionally too small for those with less than perfect vision; thankfully, text in games is big and bold. It's worth noting Elevate moves at an increasingly fast pace – when you get an answer wrong, the app moves on, rather than pausing for a teachable moment. The app is free to download but requires a pricy $39.99 annual subscription; fair warning, the 14-day trial is enough to get you hooked! **J.R. Bookwalter**

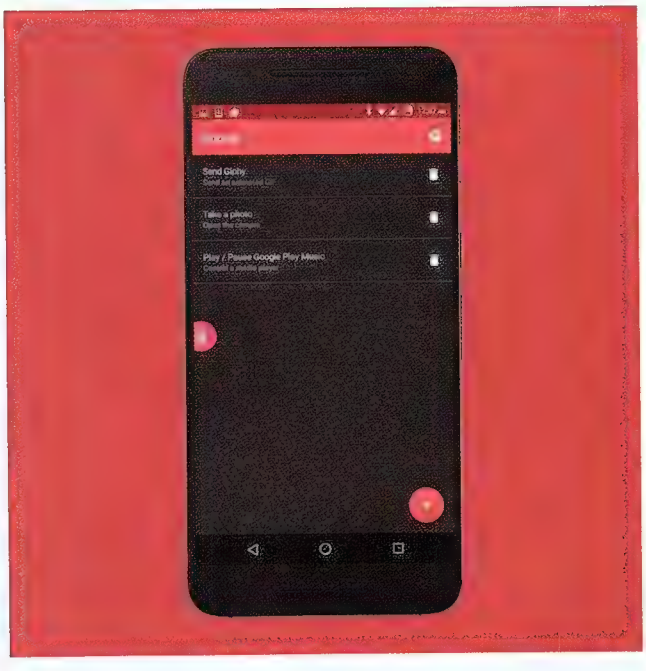


Shorty

Cut to the chase.

FREE | TINYURL.COM/TLA83-SHORTY

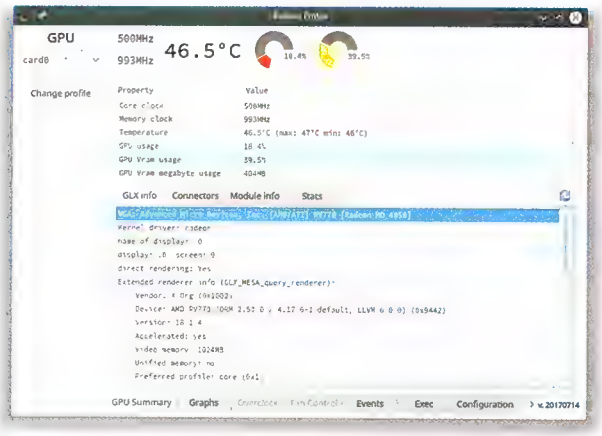
Shorty creates a custom shortcut to files, photos, notes, weblinks and more, placing a 1 x 1 icon on your homescreen. Just about anything that has the sideways 'Y" symbol or the 'Share…' menu option in your apps can be turned into a shortcut. While your web browser has bookmarks, and photo gallery may have a favourites shortcut already, Shorty's charm is that the file or whatever you need is right there, and also allows for a small amount of customisation. Rather than pinning 'IMG_20180819.jpg' to a homescreen, you can give it a more meaningful name, and chose the icon to be a photo, custom text or file symbol. There's even a colour wheel to alter the icon's background colour. Once you've designed your shortcut it lands on your homescreen, but only if there's room. If your homescreens are full, you'll have to quit, make a new 'screen, and then go through the shortcut process again. It's one of the few faults that Shorty has, along with trying to make a shortcut to apps that weren't designed to have shortcuts made for them (such as documents in Google Keep). **Paul Taylor**



Radeon-profile

Essential for every Linux AMD PC.

FREE | HTTPS://GITHUB.COM/MARAZMISTA/RADEON-PROFILE



This graphics configuration utility might seem like it's addressing the needs of a limited audience, but a little research reveals that there's actually a huge number of Linux machines running AMD video cards with open-source drivers, specifically 'radeon' for (roughly) pre-HD7000 series and 'amdgpu' for newer cards. Radeon-profile is one of many similarly-named GitHub projects, but turns out to be one of the more capable and useful. Why?

For one thing, Radeon-profile has a fully-fledged GUI; and for another, you don't need to a be guru of power profiles or the other advanced capabilities of your Radeon chip – the application presents all those things in an easy-to-understand form.

The main window instantly shows you the 'GPU Summary' details, such as the current temperature and clock speed. You can jump between tabs to find out lots of system information, including OpenGL details, screen resolution and connection type, kernel module options and a lot more. The number of sections in Radeon-profile depends on features that your graphic chip supports. Older hardware will only let you change a few settings, like the power method and power profile. In this case you can, say, disable the dynamic power management feature and select the power profile by hand. This can be useful for saving your notebook battery or reducing power consumption. Newer AMD chips work with the 'amdgpu' driver, for which this software provides a lot of extra goodness, including manual fan speed control.

Radeon-profile is a must-have tool for every Radeon-equipped Linux machine. The tool needs root privileges to run, but for more convenience you can install the system-wide daemon (**http://bit.ly/2uW295c**) from the same developer, and run the GUI part as a normal user. Go to the Configuration tab to set up the Radeon-profile tray icon and auto-start behaviour.

LibreOffice 6.1

Still one of the mosts popular suites.

FREE | WWW.LIBREOFFICE.ORG

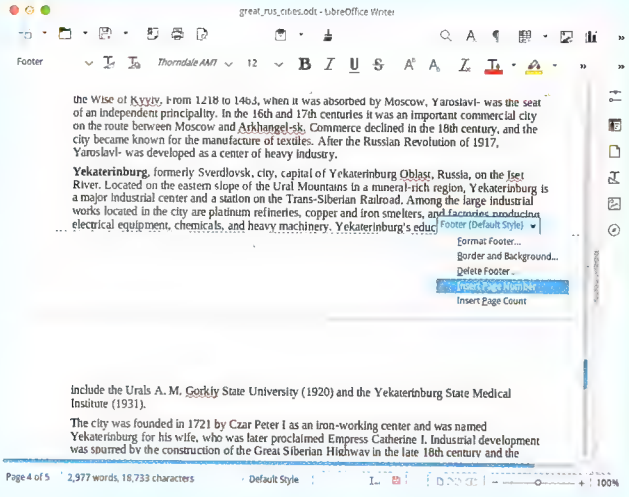
LibreOffice is a cornerstone open-source app and a long-established rival to Microsoft Office. Version 6.1, far from being just a point release of LibreOffice 6, is a major update with a host of improvements that make it worth looking at here.

The most visible change in 6.1 is that LibreOffice apps now use different icon themes, specifically the elementary set for GTK-based Linux desktops and the brand new Colibre theme for Windows.

There are other more serious changes as well, the most notable of which are stunning improvements in image handling, a long-standing shortcoming of the office suite up to now. LibreOffice now loads DOCX documents with lots of embedded images faster than before, and it can also sort cells in Calc by the size of images pasted there! Cell resizing now respects the image ratio, while all new images inserted in a spreadsheet are now anchored to their cells by default. Another feature is the new ePub export dialog. Users of Writer, perhaps the most popular part of LibreOffice, can now create professional e-books with embedded fonts and cover images, as well as huge sets of metadata. A killer feature for wannabe writers.

Regular users of LibreOffice will quickly detect various minor fixes and enhancement here and there, like the new page number insertion dialog in the header/footer menu, or the new 'spell out' chapter numbering styles in Writer.

As with any major release, the list of improvements in



LibreOffice 6.1 is long and time-consuming to read through, so much so, in fact, that we recommend you simply try the new version in your established workflow and just enjoy the experience.

The new LibreOffice 6.1 can be easily installed from Flathub (**https://flathub.org**), as well as via traditional packages in many Linux distros that provide the hottest open source releases with no delays.

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> SPEED UP BOOT TIMES
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RTX 2080 and 2080Ti - the first OEM wave

After Nvidia itself debuted a pair of impressive Founders Edition cards, Chris Szewczyk hits the Labs to see what third party cards offer.

The PC world watched as Nvidia took the covers off of its highly anticipated new generation of cards in September. It talked up some of the impressive technologies on offer, and while ray tracing and DLSS look great, we are yet to see what they can really do in the real world. For now, we have the usual assessment criteria. How do they perform in today's games? Are they leaf blowers? What's the pricing like? Are RTX cards a big jump over their predecessors?

We were very impressed with the Founders Edition cards this time around. They made a big jump in PCB quality and cooling performance. This means the aftermarket cards aren't the no brainer they once were.

As it stands now, thanks to supply and demand, exchange rates, trade wars, the early adopter tax or whatever combination of reasons, RTX cards are seriously expensive.

2080s perform admirably but if you're coming from a 1080 TI, apart from the forward-looking features, the performance jump isn't really there. The 2080 Ti is a little different. Yes it costs north of two grand, but it's also the fastest card on the market with an expected price premium.

Are they really worth it though? You'll need to consider your bank balance to provide the final answer.

A wise man once said, there are no bad graphics cards, only bad prices. Eye candy abounds, but those prices really do impact our choices. Read on as we take a look at popular 2080's and 2080 Ti's from Asus, Gigabyte and MSI.

"A wise man once said, there are no bad graphics cards, only bad prices. Eye candy abounds, but those prices really do impact our choices."

Asus ROG Strix GeForce RTX 2080 OC; 2944 CUDA cores; 1515MHz Base Clock, 1890MHz Boost Clock (OC mode); 8GB GDDR6, 256-Bit, 1400MHz Memory clock; 2x HDMI 2.0b, 2x DP 1.4, 1x USB-C, 2x8pin Power Connectors

GRAPHICS CARD

$1,699 | WWW.ASUS.COM.AU

Asus ROG Strix GeForce RTX 2080 OC

An excellent RTX 2080, but with an eye watering price.

The Asus 2080 Strix Gaming is the most feature-packed 2080 in our test. It's no surprise it comes with by far the highest price, too. It has the joint highest overclock of the bunch with a 1515MHz base clock and 1860MHz boost clock. In OC mode, the boost clock is increased to 1890MHz.

The Strix cooler is monstrous. It has excellent build quality and rigidity, though users with space considerations need to take note of its triple slot form factor. It delivered the coolest temperatures of the roundup and was second only to the MSI in fan noise, though the difference is minor.

The Asus comes with a unique pair of fan headers suitable for controlling adjacent system fans. It's the only card in the test to feature a pair of HDMI 2.0b ports in addition to a pair of DP 1.4 ports and a Type-C USB port. It comes with a healthy dose of RGB, with the side logos and shroud decked out with RGB lighting controlled by the Asus Aura Sync app.

The Asus Strix delivered the fastest results in our testing, and was easily able to hold its boost clocks above 1900MHz when set to OC mode with the GPU Tweak App. Temperatures never went above 70c in our open test bench.

The Asus delivered the best 2080 performance and has a great feature set. It's very expensive though, so it's hard to recommend vs the almost-as-good competition. Still, it's a very fine card.

Verdict

Asus has produced a stellar RTX 2080, but its price is simply too high to recommend it at this time.

apc HOT PRODUCT

Gigabyte GeForce RTX 2080 Gaming OC 8G; 2944 CUDA cores; 1515MHz Base Clock, 1830MHz Boost Clock (OC mode); 8GB GDDR6, 256-Bit, 1400MHz Memory clock; 1x HDMI 2.0b, 3x DP 1.4, 1x USB-C, 2x8pin Power Connectors

GRAPHICS CARD

$1,339 | WWW.GIGABYTE.COM.AU

Gigabyte GeForce RTX 2080 Gaming OC 8GB

If there's such a thing as a budget 2080, here it is.

The Gigabyte RTX 2080 Gaming OC aims to strike a good balance of performance and affordability, being one of the cheaper 2080s. It manages to undercut the pricing of the competing MSI and Asus models while still delivering on the most important metric: Performance. Its overclock mode is set to 1830 MHz boost clock, though it can boost to well over 1900MHz.

It uses the compact Windforce 3X cooler which does an acceptable job, and is certainly capable enough though it does mean maximum boost clocks are a touch lower and noise levels are higher, though far from unacceptable.

The Gigabyte Gaming 8G comes with clock profiles that can be activated via the simple-to-use Aorus Engine. This app controls the RBG functionality of the Gigabyte logo on the side of the card. The card has a nice looking subtle back-plate too. Video outputs consist of the standard three DP 1.4 ports, single HDMI 2.0b port and Type-C USB. The card is fed by dual 8-pin power connectors.

Despite being a 'budget' model, the Gigabyte gives up very little compared to its more expensive competitors. A couple of frames here or there won't be noticed.

The Gigabyte RTX 2080 Gaming 8G is a good all-rounder that is able to let the RTX 2080 GPU do its thing, without the bells and whistles. It mightn't have the overall polish of the MSI and Asus, but it will do its job very well and save you a few bucks too.

Verdict

Gigabyte's RTX 2080 Gaming is a no frills card that does its job well without a crazy price.

apc HOT PRODUCT

MSI GeForce RTX 2080 Gaming X Trio 8GB; 2944 CUDA cores; 1515MHz Base Clock, 1860MHz Boost Clock; 8GB GDDR6, 256-Bit, 1400MHz Memory clock; 1x HDMI 2.0b, 3x DP 1.4, 1x USB-C, 2x8pin Power connectors

GRAPHICS CARD

$1,499 | WWW.AU.MSI.COM

MSI GeForce RTX 2080 Gaming X Trio 8GB

MSI's RTX 2080 ticks all the boxes, including value.

The MSI RTX 2080 Gaming X Trio really impresses with its RGB adorned cooler and build quality along with its competitive pricing. It comes with a 1515MHz base clock and 1860MHz boost clock.

The MSI 2080 Gaming X Trio is built like a tank with a solid back plate and monstrous triple fan cooler that's easily capable of taming the TU104 GPU. Large sections of the shroud have RGB lighting, making this one a really good choice to show off in a windowed case.

The MSI features the standard set of video ports which consist of three DP 1.4 ports, a HDMI 2.0b port and the Type-C port. It's powered by six and eight pin power connectors. The MSI comes with several utilities including the popular Afterburner program along with the Dragon Center app that offers one click clock profiles and RGB control.

The MSI card is the quietest card of the roundup at the expense of very slightly higher temperatures and hence a minor drop in boost clock here and there compared to the Asus. Still, the card was able to hold clocks well over 1900MHz, so it's still very fast but does it in effective silence.

MSI has built itself an excellent reputation with its high end GPUs. The 2080 Gaming X Trio is another highly recommended and compelling choice with its competitive price and excellent cooler. Its great looks, build quality, performance and low noise levels make it our choice of 2080 card.

Verdict

MSI knocks it out of the park with a top shelf card that manages to stay competitively priced.

Asus ROG Strix GeForce RTX 2080 Ti OC; 4352 CUDA cores; 1350MHz Base Clock, 1665MHz Boost Clock (OC mode); 11GB GDDR6, 352-Bit, 1400MHz Memory clock; 2x HDMI 2.0b, 2x DP 1.4, 1x USB-C, 2x8pin Power Connectors

GRAPHICS CARD

$2,249 | WWW.ASUS.COM.AU

Asus ROG Strix GeForce RTX 2080 Ti OC

The Rolls Royce of 2080 TI cards.

The Asus ROG Strix 2080 Ti shares many of the characteristics and features of its cheaper 2080 sibling, though of course it comes equipped with the more powerful Turing TU102 GPU. It comes with a 1350MHz base clock and 1650MHz boost clock. In OC mode, the boost clock gets a minor bump to 1665MHz.

The Strix cooler is the same as the one employed by the 2080 version and it's easily capable of handling the increased demands of the Ti GPU. Again it delivered the coolest temperatures among the 2080 Ti cards.

The Strix 2080 Ti design is otherwise identical to its non Ti sibling with its unique set of twin HDMI 2.0b ports along with the pair of DP 1.4 ports and a Type-C USB port. You'll also get attractive RGB lighting capabilities and dual BIOS, with silent and performance modes to choose from.

The Asus Strix 2080 Ti was again at the head of the pack with its strong performance. The couple of degrees it saves with its capable cooler are enough to help it maintain maximum boost clocks for longer.

The Asus Strix is again the best of the 2080 Ti cards we tested. It combines an excellent feature set with a terrific cooler that extracts the maximum from the beastly TU102 GPU. You have to pay to play though. $2,249 at the time of writing is a serious amount of money to drop on a GPU. It's difficult to justify that kind of premium over competing cards.

Verdict

The Asus Strix is an excellent GTX 2080 Ti that's only let down by its exorbitant price.

apc RECOMMENDS

Gigabyte GeForce RTX 2080 Ti Gaming OC 8G; 4352 CUDA cores; 1350 Mhz Base Clock, 1665 MHz Boost Clock (OC mode); 11GB GDDR6, 352-Bit, 1400MHz Memory clock; 1x HDMI 2.0b, 3x DP 1.4, 1x USB-C, 2x8pin Power Connectors

GRAPHICS CARD

$2,049 | WWW.GIGABYTE.COM.AU

Gigabyte GeForce RTX 2080 Ti Gaming OC 8GB

A 2080 Ti that's somewhat affordable.

Yes, 2080 Tis are insanely expensive, but at least Gigabyte's 2080 Ti Gaming OC comes in at the lower end of the price spectrum. Like its non Ti sibling, it omits the bells and whistles of the higher end models while offering all the performance that a 2080 Ti can deliver. After all, cranking out FPS is what we want from a 2 grand GPU.

The Windforce 3X cooler is able to keep the demanding TU102 GPU cool enough to keep its boost clocks at high levels, without having to resort to high noise levels. We were somewhat surprised at how it performs, as the cooler certainly lacks surface area compared to the bigger cards.

Like the 2080, The Gigabyte Gaming 2080 Ti comes with a guaranteed OC mode that can be set in the Aorus Engine app. We saw clocks go to 1850MHz+, delivering a quality 4K gaming experience. The Gigabyte logo on the side of the card is RGB lit and it has that discrete looking back-plate too. Video outputs consist of the standard three DP 1.4 ports, single HDMI 2.0b port and Type-C USB. The card is fed by dual 8 pin power connectors.

Performance is strong, but it does fall a couple of FPS away from the best cards, as in the end there's no substitute for cooling when it comes to a stable, maximum boost clock.

The Gigabyte RTX 2080 Ti Gaming minimises the wallet hurt, while delivering all the performance we expect from a 2080 Ti.

Verdict

Gigabyte's RTX 2080 Ti Gaming is a good way to join the elite 2080 Ti owners club.

★★★★½

apc HOT PRODUCT

MSI GeForce RTX 2080 Ti Gaming X Trio 11GB; 4352 CUDA cores; 1350MHz Base Clock, 1755MHz Boost Clock; 11GB GDDR6, 352-Bit, 1400MHz Memory clock; 1x HDMI 2.0b, 3x DP 1.4, 1x USB-C, 2x8pin, 1x 6pin Power connectors

GRAPHICS CARD

$2,099 | WWW.AU.MSI.COM

MSI GeForce RTX 2080 Ti Gaming X Trio 11GB

It's pricey but excellent nontheless.

The MSI RTX 2080 Ti Gaming X Trio is almost identical to the highly recommended 2080 version. Of course the Ti packs in the more powerful TU102 GPU. It comes with a 1515MHz base clock and 1860MHz boost clock.

The MSI 2080 Ti Gaming X Trio uses the same cooler as the 2080 version, and it's every bit as effective at cooling the hotter Ti GPU. MSI seems to have tuned it for acoustic performance above all as it stayed quiet under every circumstance. It looks terrific with its RGB adornments. Do note that it's a very tall card, so it will not fit in slim cases as the NV-Link shroud pokes a good four cm above the backplate.

The MSI 2080 Ti comes with the standard three DP 1.4 ports, a HDMI 2.0b port and the Type-C port. It's the only Ti card in our test to make use of dual eight pin plus single six pin power connectors. Go on. Overclock it. You'll need MSI's Afterburner program to get the best out of it. It's an excellent app that every gamer should have installed.

The MSI was the quietest Ti card of the roundup yet was still able to boost to very high levels beyond the official boost clock.

MSI's Gaming cards continue to impress. MSI has resisted over pricing its Gaming X Trio cards and for this reason they come highly recommended. The Asus is also a very good card but MSI has it beat on value.

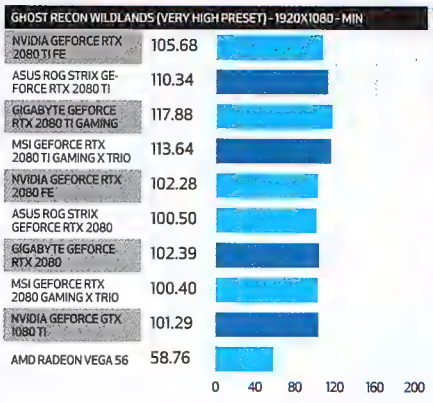
Verdict

MSI's 2080 Ti is a silent tank that easily tames the demanding 2080 Ti GPU.

★★★★½

"2080's perform admirably but if you're coming from a 1080 TI, apart from the forward-looking features, the performance jump isn't really there."

LABS BENCHMARK RESULTS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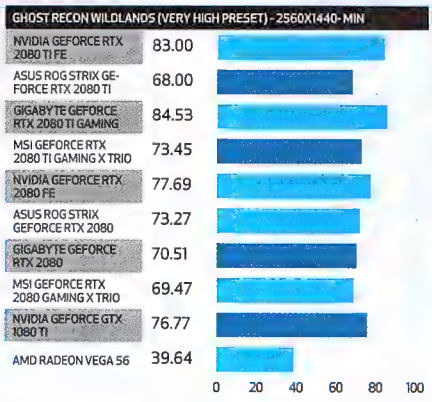
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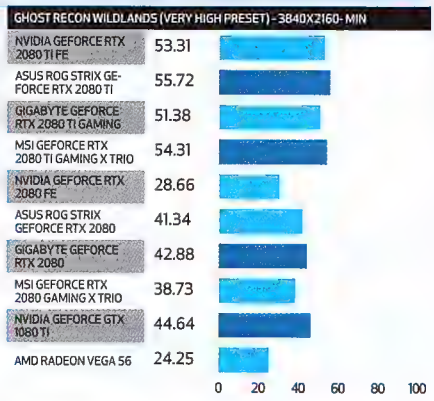
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ASUS ROG STRIX GEFORCE RTX 2080 41.34
GIGABYTE GEFORCE RTX 2080 42.88
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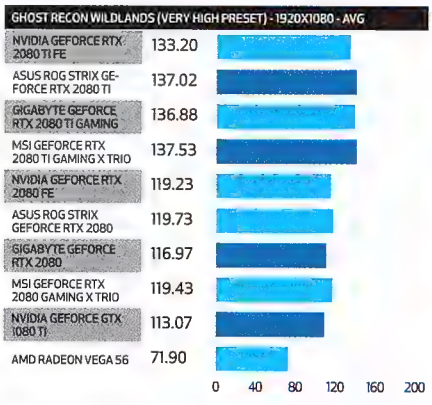
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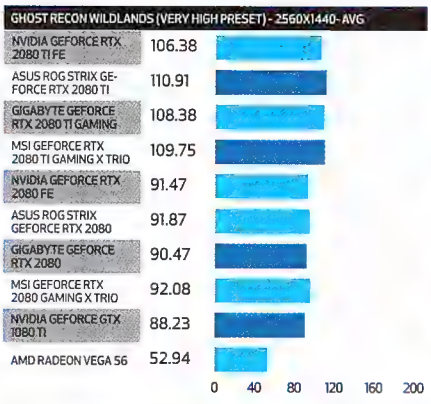
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ASUS ROG STRIX GEFORCE RTX 2080 91.87
GIGABYTE GEFORCE RTX 2080 90.47
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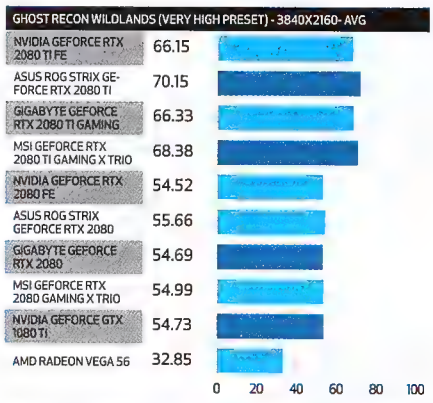
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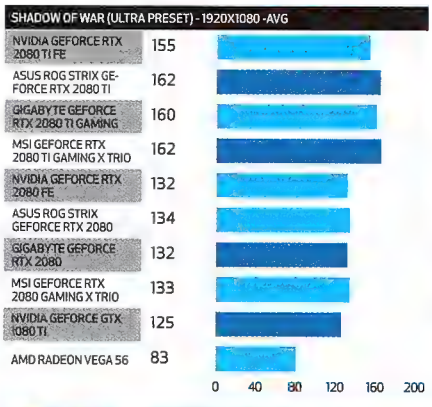
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NVIDIA GEFORCE RTX 2080 FE 132
ASUS ROG STRIX GEFORCE RTX 2080 134
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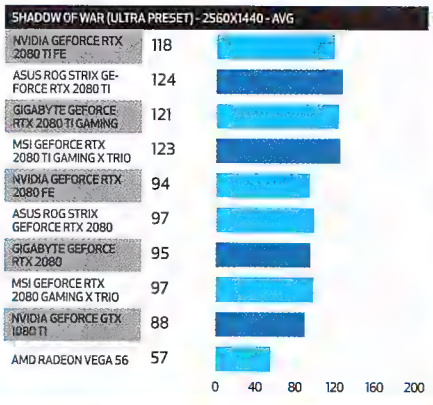
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NVIDIA GEFORCE RTX 2080 FE 94
ASUS ROG STRIX GEFORCE RTX 2080 97
GIGABYTE GEFORCE RTX 2080 95
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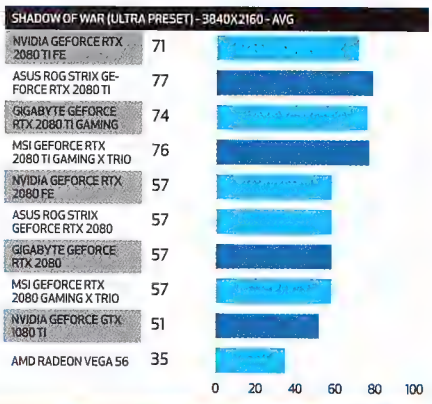
SHADOW OF WAR (ULTRA PRESET) - 3840X2160 - AVG
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MSI GEFORCE RTX 2080 TI GAMING X TRIO 76
NVIDIA GEFORCE RTX 2080 FE 57
ASUS ROG STRIX GEFORCE RTX 2080 57
GIGABYTE GEFORCE RTX 2080 57
MSI GEFORCE RTX 2080 GAMING X TRIO 57
NVIDIA GEFORCE GTX 1080 TI 51
AMD RADEON VEGA 56 35
0 20 40 60 80 100

SYNTHETIC TESTS AND TEMPERATURES

	3DMARK FIRESTRIKE	3DMARK FIRESTRIKE EXTREME	TEMPERATURES @ IDLE	TEMPERATURES @ LOAD
NVIDIA GEFORCE RTX 2080 TI FE	26281	15647	35	73
ASUS ROG STRIX GEFORCE RTX 2080 TI	26913	16508	34	68
GIGABYTE GEFORCE RTX 2080 TI GAMING	26322	15896	36	72
MSI GEFORCE RTX 2080 TI GAMING X TRIO	26774	16323	33	70
NVIDIA GEFORCE RTX 2080 FE	23560	12759	35	71
ASUS ROG STRIX GEFORCE RTX 2080	23677	12908	34	66
GIGABYTE GEFORCE RTX 2080	23263	12614	34	71
MSI GEFORCE RTX 2080 GAMING X TRIO	23650	12898	31	68
NVIDIA GEFORCE GTX 1080 TI	23564	13097	39	80
AMD RADEON VEGA 56	16677	8439	36	71

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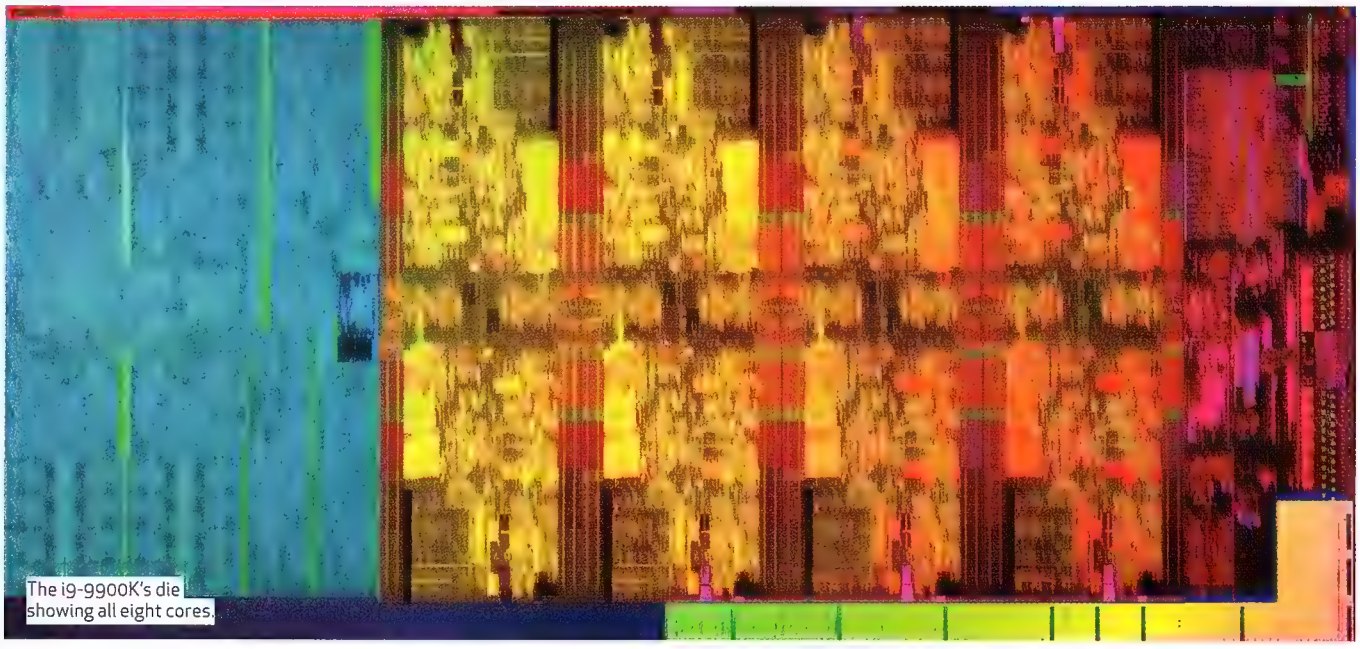


The i9-9900K's die showing all eight cores.

Intel 9th-gen CPUs

Core counts go up, i9 hits the mainstream and a thin sliver of solder makes all the difference. Ben Mansill overviews Intel's new generation of desktop CPUs.

With Intel's 9th-gen desktop CPUs we see the i9 come to the fore, replacing the i7 as the hero product and joining the mainstream consumer line, where once it was a 'prosumer' CPU. It is still a premium CPU, but by the looks of Intel's marketing and product positioning the i9 is the new i7 in terms of it being the likely choice for gamers and home power users.

There are three new lines in the 9th-gen range: the regular mainstream Core series (i5, i7, and i9), the prosumer X-Series, plus a new Xeon. Gaming continues to be the central focus of the regular Core line. The X-series are for prosumers, with Intel banging the content creation drum for this potential set of customers. Separating the two families on a technical level, broadly speaking the X-series gets quad-channel memory vs dual-channel for the mainstream, and more PCIe lanes.

The star of the show is absolutely the i9-9900K, and rightly so. It's an exciting prospect to have a 8 core + 8 hyperthreads CPU that can Turbo at up to 5GHz out of the box. Base speeds of 3.6GHz for the 9900K are respectable, but the real action comes from the re-introduction of proper Thermal Interface Material (TIM), which will undoubtedly allow better overclocking – as Chris confirmed during his testing.

TIM?

The reintroduction of proper Thermal Interface Material after years of using a cheaper solution is welcome. Intel has long suffered criticism for replacing solder with less conductive paste years ago, while AMD went with solder for its Ryzen and Threadripper chips. Soldered TIM allows higher frequencies via better thermal dissipation, both at stock and when overclocking. Soldered TIM will allow more CPUs from a production die to be allocated to higher frequency CPUs, and thus more CPUs allocated as performance parts, lowering the final cost and reducing the chance of supply issues like Intel is currently facing with its 8th-gen CPUs. It's why we're seeing the i9 9900k Turbo at 5GHz.

All the CPUs in the new range are produced on the 14nm process, which Intel's been on since its 5th generation. Which makes it even more critical that Intel reintroduced

9TH-GEN INTEL CORE

PROCESSOR NUMBER	BASE CLOCK SPEED (GHZ)	INTEL TURBO BOOST	CORES / THREADS	TDP	INTEL SMART CACHE	UNLOCKED	PLATFORM PCIE LANES	MEMORY SUPPORT	INTEL OPTANE MEMORY SUPPORT	PRICING
9TH GEN INTEL CORE I9-9900K	3.6	5.0	8/16	95W	16MB	YES	UP TO 40	TWO CHANNELS DDR4-2666	YES	$859
9TH GEN INTEL CORE I7-9700K	3.6	4.9	8/8	95W	12MB	YES	UP TO 40	TWO CHANNELS DDR4-2666	YES	$659
9TH GEN INTEL CORE I5-9600K	3.7	4.6	6/6	95W	9MB	YES	UP TO 40	TWO CHANNELS DDR4-2666	YES	$459

Intel simultaneously launched 9th-gen Core and X-series CPUs.

> "Intel's own benchmarks show a 10-11% gain in gaming performance over the last gen, which is so small it's just impossible to justify upgrading."

TIM. A sliver of solder isn't nearly as sexy a story as a reduction in the nano-scale size of the circuits on the chip, but it's allowed Intel to hit those high clock speeds.

Another very welcome gain is in the number of PCIe lanes, which are up to 40 on the three new mainstream 9th-gen Core CPUs, and up to 68 on the higher-end X-Series. AMD no longer has the edge here.

KEEPING FAMILIES APART

The X-series gains seven new CPUs compared to just three for the Core series. You'll be able to drop a new X-series into an existing X299 motherboard; it's been a while since Intel offered backwards compatibility so this is a step in the right direction. The mainstream 9th-gen CPUs can be also used with any existing 300-series motherboard, so while it is true that there is backwards compatibility on offer, that platform is so new that it's unlikely anyone that bought one in the last year would actually need to upgrade their CPU so soon.

X-series CPUs also support quad-channel memory, while it's dual-channel-only for Core.

Relative to the previous 8th-gen CPUs, 9th-gen gains two more cores and an additional 400MHz on the clock. Power is still 95w.

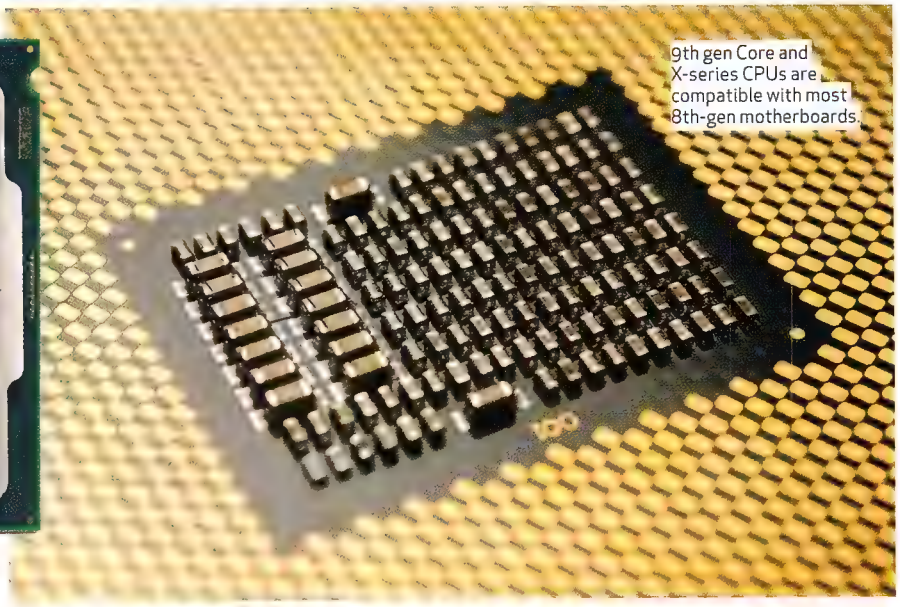
Intel's own benchmarks show a 10-11% gain in gaming performance over the last gen, which is so small it's just impossible to justify upgrading from 8th-gen. Even so, the 9900K is very likely to repeat the huge success Intel has (and continues to have) with the mighty i7-8700K, which has already earned a place in the CPU book of legends as a game changer. The ability to hit 5GHz on a single core is impressive as Intel's factory Turbo speed, but overclockers will likely find even more headroom. The 9900K is capable of running at closer to 6GHz with a custom water cooler, and an off the shelf AIO cooler should be sufficient to get the 9900K stable at over 5GHz on all cores.

THE NEW TOP DOG

With the i9 range now firmly established by Intel as the top dog, the i7 still offers terrific performance and value, coming in at $200 less than the i9, the i7 9700K offers eight cores at 3.6GHz and single-core Turbo of 4.0GHz.

It's significant that this i7 no longer has hyperthreading (HT). It's the first i7 to have no support for HT and it's got nothing to do with the chip's capabilities – this is purely marketing with Intel enshrining the i9 as the premium product. While the 8th-gen i7 and i9 both had HT, it's Intel's view that

Intel hopes the i9-9900k will appeal to users that previously stuck with the i7.



9th gen Core and X-series CPUs are compatible with most 8th-gen motherboards.

Following AMD's lead, Intel gets creative with the premium product packaging.

8th-gen i9 wasn't a 'mainstream' CPU. Now it is, so the i7 has been relegated to the lowly status of an i5 with only physical cores. Interestingly Intel is pushing the hyperthreaded i9 as the "best gaming CPU in the world", but as most gamers know HT isn't critical to gaming, so the now HT-less i7 may end up being the best bang for the buck gamer CPU.

The new i5-9600K offers six cores at 3.7GHz – which, notably, is 100MHz faster than the i7, though it Turbos 300MHz lower (4.6 vs 4.9). This is partly marketing, but the binning process also affects how a CPU is branded after it comes off the die. Fewer CPUs, evidently, yield the highest single core performance, and that's what makes them an i7 instead of an i5.

TAKING IT TO AMD

Intel couldn't let AMD get all the attention with its 32-core Threadripper 2. Its top of the line X-Series i9 9980XE is a way short with 'just' 18 cores (and another 18 HTs), and those cores are running at a relatively conservative 3GHz, too. The benchmarks may tell a different story, though. Intel is boasting that its 'Mesh' architecture, which interconnects all the CPU cores with all available cache memory is more efficient than AMD's Infinity Fabric, which limits simultaneous use of all memory channels for all active cores. AMD needed to compromise with the Threadripper 2 to pack 32 cores in, with not all of them able to access the memory simultaneously and at full bandwidth, though in real world use the impact is minimal.

What the X-series does get, that the mainstream Core range does not, is Turbo Max boost. That allows two cores to be Turbo boosted instead of just the one on the main Core product range. Those cores are identified during the binning process and will be fed lightly threaded work when in Max boost mode so the cores can hit top speed, which is 4.5GHz for all but the lowliest i9-9820X CPU, which hits 4.2GHz in Max boost.

There's no denying that the size of the X-series range will make the decision about which to buy tricky. There's little separating them other than core count, and they span seven CPUs. But the whole idea with the X-Series is scalability, and that's precisely why the range is the way it is – these are multi-core CPUs with a wide variety of choices of how many cores you want, but are otherwise almost identical. Most professionals use a small number of apps, and they should be familiar with how many cores/threads offer the optimal price and performance balance, so the X-Series gives you that choice with its expansive range.

It's helpful, too, that the price distinctions are more pronounced, with a quadrupling of the price when you go from the bottom to the top range product. All offer quad-channel DDR4 support, all have up to 68 PCIe lanes, and they all run at 165w at almost identical clock speeds.

We'll have reviews of more 9th-gen CPUs in the next issue of APC, but for now we've been testing the i7-9700K as well as some of the new Z390 motherboards, which you'll find on the following pages.

INTEL CORE X-SERIES

PROCESSOR NUMBER	BASE CLOCK SPEED (GHZ)	INTEL TURBO BOOST	INTEL TURBO BOOST MAX TECHNOLOGY 3.0 FREQUENCY (GHZ)	CORES / THREADS	IN-TELSMART CACHE	PLATFORM PCIE 3.0 LANES	UNLOCKED	TDP	MEMORY SUPPORT	INTEL OPTANE MEMORY SUPPORT	PRICING (USD 1K)
INTEL CORE X-SERIES I9-9980XE	3.0	4.4	4.5	18/36	24.75 MB	UP TO 68	YES	165W	FOUR CHANNELS DDR4-2666	YES	$1,979
INTEL CORE X-SERIES I9-9960X	3.1	4.4	4.5	16/32	22 MB	UP TO 68	YES	165W	FOUR CHANNELS DDR4-2666	YES	$1,684
INTEL CORE X-SERIES I9-9940X	3.3	4.4	4.5	14/28	19.25 MB	UP TO 68	YES	165W	FOUR CHANNELS DDR4-2666	YES	$1,387
INTEL CORE X-SERIES I9-9920X	3.5	4.4	4.5	12/24	19.25 MB	UP TO 68	YES	165W	FOUR CHANNELS DDR4-2666	YES	$1,189
INTEL CORE X-SERIES I9-9900X	3.5	4.4	4.5	10/20	19.25 MB	UP TO 68	YES	165W	FOUR CHANNELS-DDR4-2666	YES	$989
INTEL CORE X-SERIES I9-9820X	3.3	4.1	4.2	10/20	16.5 MB	UP TO 68	YES	165W	FOUR CHANNELS-DDR4-2666	YES	$898
INTEL CORE X-SERIES I7-9800X	3.8	4.4	4.5	8/16	16.5 MB	UP TO 68	YES	165W	FOUR CHANNELS-DDR4-2666	YES	$589

Benching the 9th-gen

We've been running the numbers on our early sample 9th-gen i7-9700K, stacking it up against the equivalent CPU from the previous two generations of Intel CPUs.

Now that we've gone over the ranging, let's take a look at how our sample i7-9700K compares to its predecessors, the i7-8700K and i7-7700K. We ran a few simple benchmarks to compare them. To be honest, we expected the 8700K to maintain a lead in multithreaded benchmarks due to its twelve logical cores vs the eight physical cores of the 9700K. We were surprised to see that the 9700K maintained a healthy lead in every circumstance.

Less surprising was the single threaded Cinebench test, where the superior boost clocks of the 9700K saw it take the lead. This strong single threaded performance bodes well for gaming, which will make use of the strong single thread performance on offer.

At the time of writing we didn't have the pricing of the 9700K, so any real conclusion is impossible, but it seems clear that the 9700K will make for a very good CPU, with its mix of strong multithreaded performance and gaming performance. As long as its priced right!

Intel's switch from a standard Thermal Interface Material to a solder-based TIM has delivered clear thermal benefits. Pushing our sample to 5.1GHz was exceptionally easy, but once you start moving to 1.35v and beyond, temperatures still start to ramp up very quickly. We can't draw too many conclusions from one sample but the early indicators are that Intel's 8-core CPUs have a lot of headroom. If you have a good quality all-in-one CPU cooler, or even better, a custom loop, it appears as though you're in for some fun. ■ **Chris Szewczyk**

LABS
3DMARK FIRESTRIKE SCORE
INTEL CORE I7-9700K 23,272
INTEL CORE I7-8700K 22,500
INTEL CORE I7-7700K 21,105
0 10,000 20,000 30,000 40,000 50,000
CINEBENCH 15 MULTI THREAD SCORE
INTEL CORE I7-9700K 1519
INTEL CORE I7-8700K 1417
INTEL CORE I7-7700K 990
0 400 800 1200 1600 2000
CINEBENCH 15 SINGLE THREAD SCORE
INTEL CORE I7-9700K 207
INTEL CORE I7-8700K 204
INTEL CORE I7-7700K 196
0 100 200 300 400 500
7ZIP MILLION INSTRUCTION PER SECOND
INTEL CORE I7-9700K 41,399
INTEL CORE I7-8700K 39,196
INTEL CORE I7-7700K 28,331
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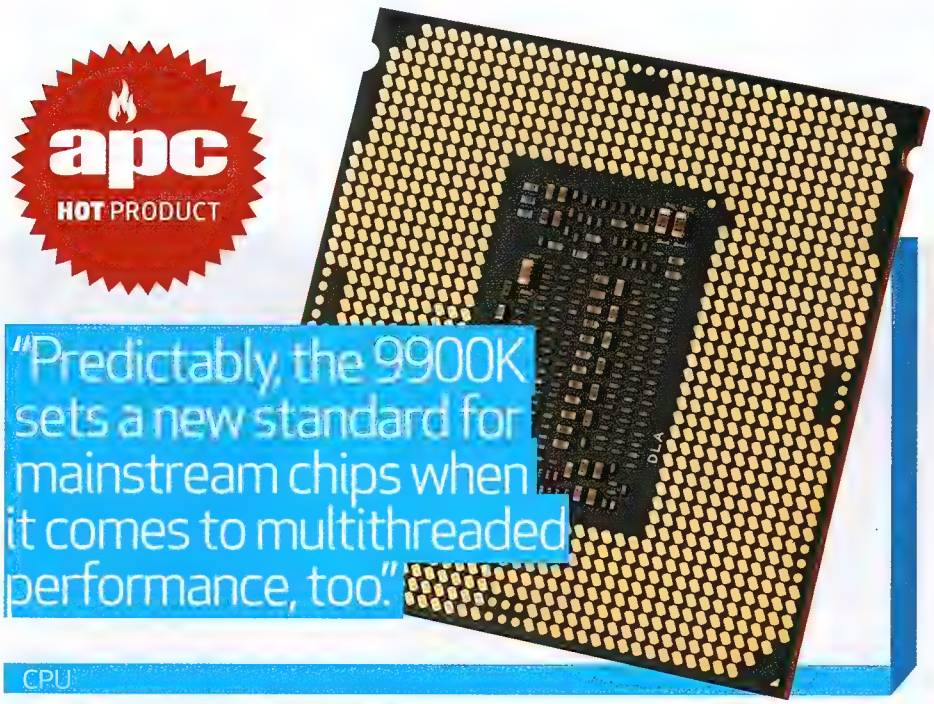
"Pushing our sample to 5.1GHz was exceptionally easy, but once you start moving to 1.35v and beyond, temperatures still start to ramp up very quickly."



"Predictably, the 9900K sets a new standard for mainstream chips when it comes to multithreaded performance, too."

CPU

$859 | WWW.INTEL.COM

LABS BENCHMARK RESULTS
CINEBENCH R15 SINGLE (INDEX)
INTEL CORE I9-9900K 214
INTEL CORE I7-8086K 212
AMD RYZEN 7 2700X 180
0 50 100 150 200 250
CINEBENCH R15 MULTI (INDEX)
INTEL CORE I9-9900K 1,994
INTEL CORE I7-8086K 1,630
AMD RYZEN 7 2700X 1,814
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POWER DRAW IDLE (WATTS)
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INTEL CORE I7-8086K 69
AMD RYZEN 7 2700X 91
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POWER DRAW LOAD (WATTS)
INTEL CORE I9-9900K 185
INTEL CORE I7-8086K 200
AMD RYZEN 7 2700X 221
0 50 100 150 200 250
GHOST RECON WILDLANDS (FPS)
INTEL CORE I9-9900K 62
INTEL CORE I7-8086K 61
AMD RYZEN 7 2700X 55
0 20 40 60 80 100
3DMARK FIRE STRIKE (INDEX)
INTEL CORE I9-9900K 19,428
INTEL CORE I7-8086K 19,563
AMD RYZEN 7 2700X 17,855
0 4000 8000 12000 16000 20000

Intel Core i9-9900K

Even more mainstream cores from Intel.

Cast your mind back to late 2006. That's when Intel introduced its first desktop quad-core CPU. Fast-forward nearly 11 years later to summer 2017, and what had changed? In terms of core counts, not much. Intel's mainstream desktop socket was still limited to just four cores.

OK, you could buy so-called desktop chips with more than four cores, but they were part of what was and remains today a series of rebadged server platforms, complete with costly multi-channel memory controllers and other features that up the price but do little to enhance the desktop computing experience. Yet here we are in late 2018, reviewing a mainstream eight-core CPU from Intel, just a year after it unveiled its first six-core mainstream chips. What, exactly, is going on?

The answer is Ryzen. Whatever Intel or anyone else says, there is no way the new Core i9-9900K would exist without the arrival of AMD's fantastic new Ryzen CPU last year. Ryzen isn't perfect, but it has been good enough to wake Intel from its slumber. The result is a rapid acceleration of Intel's road map, and a doubling of its mainstream desktop core count in little more than a year.

The new 9900K fits into a larger refresh of CPUs for the mainstream LGA1151 socket. This is Intel, of course, so the precise makeup of the new 9th Gen family isn't just difficult to get your head around; it's actually frustrating. That's chiefly because with this new 9000 series of CPUs, Intel has once again rejigged its HyperThreading implementation. Put simply, HyperThreading is gone, save for the top-end eight-core 9900K processor with 16 threads. That's frustrating, because the feature remains present in all the chips—Intel has simply disabled it in order to create an artificial product hierarchy.

All that absorbed, how does this range-topping member of the new 9th-gen series perform? Intel rates it at 3.6GHz base clock, and has set the maximum Turbo frequency at 5GHz – just remember, the latter is not an all-cores frequency. Nevertheless, it does ensure the new 9900K delivers epic single-threaded performance. It's on a par with the existing single-thread king, the Core i7-8086K, in that regard.

Predictably, the 9900K sets a new standard for mainstream chips when it comes to multithreaded performance, too. Yes, it duly tears AMD's top Ryzen chip, the 2700X, a new one across the board. In fact, in a desktop context, it's quick enough to make the likes of Intel's 10-core 7900X, a server-derived CPU for the LGA2011 socket, look redundant.

Inevitably, the 9900K's one arguable weakness involves overclocking. At stock settings, it typically runs at 4.7GHz across all eight cores when under heavy load. We managed to crank that up to 5GHz on all cores. That's a six-and-a-bit percent overclock, and not enough to really impact your subjective computing experience in the real world. Given the number of cores and the already high clock speeds Intel has enabled as standard for the 9900K, the limited scope for overclocking is not a surprise.

The 9900K and the rest of the new 9th-gen gang are compatible with existing 300-series motherboard chipsets, although actual mileage will vary from board to board. As ever, check with the manufacturer for details regarding required BIOS updates.

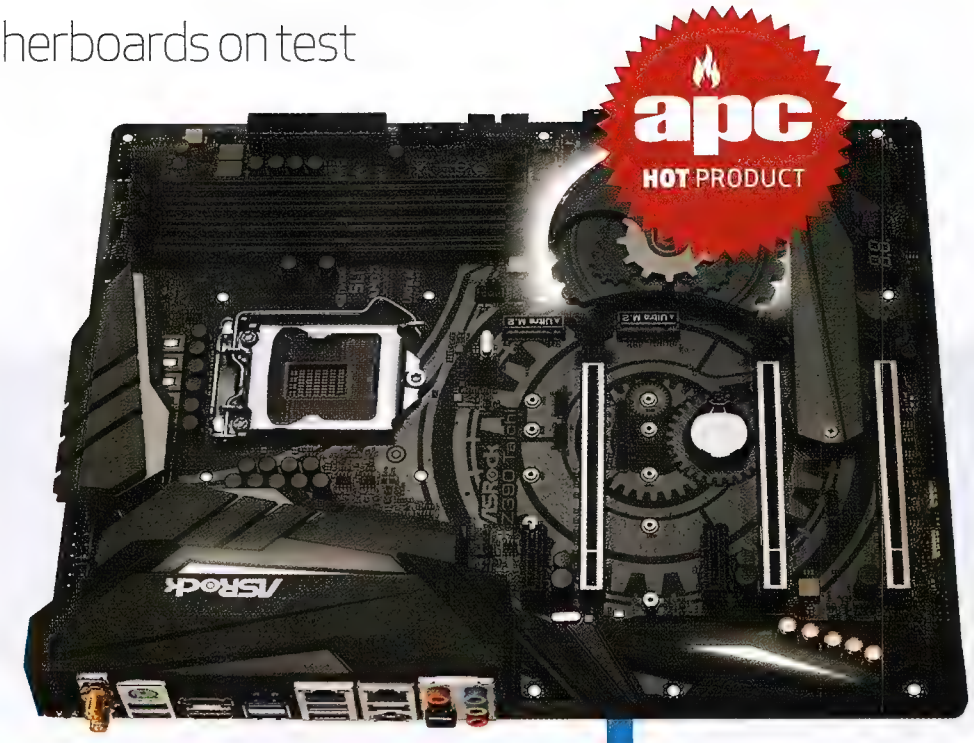
Jeremy Laird

Verdict

Huge single-core and multithreaded performance; uses mainstream socket. Not much overclocking headroom.

Z390 Labs-tested

With a new CPU generation comes a new chipset. Chris Szewczyk.



ASRock Z390 Taichi; Intel Z390 Chipset; Socket 1151; Support for 8th & 9th generation Intel Core Processors; 3x M.2; 8x SATA; up to 5x USB 3.1 Gen 2, up to 8x USB 3.1 Gen 1, up to 3x USB 2.0; 802.11ac Wi-Fi, Intel I211AT & I219V Gigabit LAN; 1x HDMI; 1x DisplayPort 1.2; Realtek ALC1220 7.1 Channel High Definition Audio; ATX Form Factor

$399 | WWW.ASROCK.COM

ASRock Z390 Taichi

Price and performance in balance.

ASRock's Z390 Taichi stands alone as the only 'normal' motherboard in our roundup. The Taichi brand successfully targets non-gaming users who aren't interested in gaming bells and whistles.

The Z390 Taichi closely follows the design cues of its predecessors. The chipset heatsink has a particularly nice look. It has some of splashes of RGB lighting around the chipset heatsink, I/O cover and audio section. The VRM heatsinks for most Z390 boards have really been beefed up and there's a heatpipe connecting the two large, screw-down heatsinks.

To cope with the increased demands of eight-core 9th generation processors, ASRock incorporated a twelve-phase power delivery system powered by eight plus four pin power connectors. It's the only board in the roundup to feature eight SATA connectors. It manages to pack in three M.2 slots, one of which features a large heatsink, though due to PCIe lane restrictions not all SATA and M.2 ports can be run at the same time.

The rear I/O is well equipped with 802.11ac Wi-Fi built in. There's four USB 3.0 ports, and four 3.1 ports, one of which is a Type-C. We have Intel's Gigabit I211AT and I219V controllers powering the two LAN ports onboard. There's HDMI and DisplayPort present, a PS/2 port, CMOS clear button and audio ports with S/PDIF.

The Z390 Taichi BIOS is all but unchanged from the Z370 version, and why would you need to change it? ASRock continues to produce one of the easier to navigate BIOS layouts on the market.

The Z390 platform, being an evolution of Z370, which is in turn an evolution of Z270 and so on, means that the platform is well and truly mature. Using relative performance to differentiate between boards is almost irrelevant given the tiny differences we saw. The Taichi's CPU, graphics, memory and storage performance is right where we expect it to be.

OC with the Taichi was dead easy. Our 9700K sample is cooling limited above 1.35v and so the motherboard itself was not a limiting factor. The Taichi was easily able to handle full load at 5.1GHz at 1.35v with the memory overclocked to DDR4-3866. It was nice to see a 'budget' board perform as well as those costing as lot more.

The reputation of the ASRock Taichi series continues to be enhanced. It looks good and has a core feature set that mostly matches the higher end boards. Overclocking and performance numbers are dead on what we expect from a now mature platform. If you're on a budget, and wish to divert some extra dollars towards a bigger SSD or better GPU, then the Z390 Taichi should definitely be on your radar.

Verdict

A terrific value board that doesn't compromise when it comes to key features.

★★★★½

LABS BENCHMARK RESULTS

3DMARK FIRESTRIKE - SCORE	MIDDLE EARTH: SHADOW OF WAR - 1080P, LOW, AVG FPS	GHOST RECON: WILDLANDS - 1080P, LOW, AVG FPS	X264 FHD VIDEO ENCODING - FPS	CINEBENCH 15 MULTI THREAD SCORE	CINEBENCH 15 SINGLE THREAD SCORE	7ZIP MILLION INSTRUCTION PER SECOND	AS-SSD - SCORE
23118	222	189.19	54.15	1527	207	41189	4411

Asus ROG Maximus XI Formula; Intel Z390 Chipset; Socket 1151; Support for 8th & 9th generation Intel Core Processors; 2x M.2; 6x SATA; up to 5x USB 3.1 Gen 2, up to 10x USB 3.1 Gen 1, up to 4x USB 2.0; 802.11 a/b/g/n/ac Wi-Fi, Intel I211AT 1G & Aquantia AQC-111C 5G LAN; 1x HDMI; Realtek ALC1220 7.1 Channel High Definition Audio; ATX Form Factor

$729 | WWW.ASUS.COM/AU

Asus Maximus XI Formula

Turning the features – and price – right up to XI.

Asus has been churning out ROG motherboards since 2006 and here we are with the 11th iteration of the venerable Maximus.

A visual inspection of the board clearly shows that Asus is targeting water cooling users with the Formula. The VRM is cooled by an EK waterblock while we counted seven fan headers plus additional water cooling specific headers.

Of course there's plenty of RGB onboard as you'd expect, but the most eye-catching feature is the LiveDash OLED panel. It can be used to display various monitoring information or even your own custom image or animation. It's really cool. The storage features consist of an average set of six SATA ports and a pair of M.2 slots. There's also a quality metal backplate. This is a really heavy motherboard that's built like a battleship.

The I/O area has an integrated shield and is chock full of ports. There's four USB 3.1 ports, one of which is a Type-C, along with six USB 3.0 ports. Along with the standard audio ports, there's a single HDMI port, BIOS flashback and CMOS clear buttons. Now we come to those dual LAN ports. One of them is connected to an Intel I219V Gigabit controller, while the other uses an Aquantia 5G controller. Slowly we're starting to see the winds of change, with infrastructure faster than ancient Gigabit LAN becoming more commonplace. We're very happy to see 5G included on the Maximus XI Formula. AC Wi-Fi is common on high end boards these days, but not necessarily the faster 1.73Gbps speed we have here. The Maximus XI Formula is definitely a networking powerhouse.

Asus' ROG UEFI BIOS is little changed from previous generations. Users familiar with Asus BIOS will be right at home, however it can be a bit overwhelming at times for inexperienced users. Users wanting to extract every fraction of performance will be right at home with the extensive memory tweaking options, profiles to try and a million other tweaks to play with.

Performance is bang on where we expected. It proved to be quite strong with graphics applications, though as we thought, the differences between all the boards in the test are very minor. The board didn't raise a sweat when it came to our CPU and memory overclocking tests. CPU cooling limitations present themselves long before the board gets stressed.

The Asus Maximus XI Formula comes across as a really refined board that's tailor made for watercoolers and modders looking to show off their rigs. We love the OLED panel, cooling options, build quality and networking prowess. There's no doubt it's a pricey proposition but it's the kind of price that's justified thanks to its unique and innovative feature set.

Verdict

Perfectly tailored for serious modders and water cooling enthusiasts, but be prepared to pay a pretty penny.

★★★★★

LABS BENCHMARK RESULTS

3DMARK FIRESTRIKE - SCORE	MIDDLE EARTH: SHADOW OF WAR - 1080P, LOW, AVG FPS	GHOST RECON: WILDLANDS - 1080P, LOW, AVG FPS	X264 FHD VIDEO ENCODING - FPS	CINEBENCH 15 MULTI THREAD SCORE	CINEBENCH 15 SINGLE THREAD SCORE	7ZIP MILLION INSTRUCTION PER SECOND	AS-SSD - SCORE
23272	223	190.08	54.32	1525	207	41399	4486

apc RECOMMENDS

"It packs in a twelve phase PWM powered by dual eight pin connectors, which when combined with the cooling assembly, means there's plenty of grunt on hand even if you're into extreme overclocking."

$569 | WWW.GIGABYTE.COM.AU

Gigabyte Z390 Aorus Master; Intel Z390 Chipset; Socket 1151; Support for 8th & 9th generation Intel Core Processors; 3x M.2; 6x SATA; up to 5x USB 3.1 Gen 2, up to 4x USB 3.1 Gen 1, up to 8x USB 2.0; 802.11 a/b/g/n/ac Wi-Fi, Intel Gigabit LAN; 1x HDMI; Realtek ALC1220-VB 7.1 Channel High Definition Audio; ATX Form Factor

Gigabyte Z390 Aorus Master

Masterful craftsmanship.

Gigabyte has rejigged its branding. It's a little difficult to know if a 'Master' is higher than an 'Ultra' in the product stack, for example. We have the Z390 Aorus Master on hand for review. Take one look at it though, and you know this is high end. It just oozes quality craftsmanship.

While many high-end boards these days focus on aesthetics ahead of function, Gigabyte has managed to do both. The heatsink is a work of art. It makes use of a traditional finned structure for maximum surface area, while retaining an eye-catching metal design with RGB elements; it really looks great, but does an exceptional cooling job too. It packs in a twelve phase PWM powered by dual eight pin connectors, which when combined with the cooling assembly, means there's plenty of grunt on hand even if you're into extreme overclocking.

There are three M.2 heatsinks and they look fantastic with their machined aluminium finish. Gigabyte is also known for its impressive audio implementations and the Aorus Master continues this trend with an onboard ESS Sabre DAC and dedicated USB ports. It also includes 802.11 AC Wave 2 functionality, delivering up to 1733 Mbps speed. This mostly makes up for the omission of a 2.5Gbps+ LAN connection that we feel is an oversight in this price range.

The I/O area has a good helping of ports including the AC Wi-Fi antennas. There's four USB 3.1 ports including a single Type-C, two 3.0 ports and a four 2.0 ports. USB 2.0 ports are almost absent from the other boards, but for things like a mouse or keyboard, they are perfectly adequate. Interestingly there's a power button on the rear and finally there's single HDMI port, the audio ports, Intel Gigabit LAN port, and CMOS clear button.

The Aorus Master performed well in our benchmark test suite. As we expect, all the boards perform very closely to one another so there are no surprises.

The Gigabyte UEFI implementation is simple and easy to use, with all the important features well laid out. We generally prefer the ASRock and MSI BIOS layouts, but still there's everything you need to extract the most from your CPU and memory.

Overclocking with K series processors is as easy as ever and the Master had plenty left in the tank before our CPU ran into its temperature limits. It ran our memory at DDR4-3866 with zero effort.

Gigabyte has produced a wonderful looking board with some key differentiating features. The audio is top notch and it'll be perfect for large M.2 arrays, but $569 is a good chunk of change. All the boards here in our roundup are mature and refined, so your choice may even come down to brand loyalty.

Verdict

Gorgeous looking and refined, but its price hurts it in a very competitive market.

★★★★½

LABS BENCHMARK RESULTS

3DMARK FIRESTRIKE - SCORE	MIDDLE EARTH: SHADOW OF WAR - 1080P, LOW, AVG FPS	GHOST RECON: WILDLANDS - 1080P, LOW, AVG FPS	X264 FHD VIDEO ENCODING - FPS	CINEBENCH 15 MULTI THREAD SCORE	CINEBENCH 15 SINGLE THREAD SCORE	7ZIP MILLION INSTRUCTION PER SECOND	AS-SSD - SCORE
23216	223	189.68	54.03	1522	208	40992	4558

"One of the first things to catch your eye is the dial at the bottom right of the board. This is an automatic overclocking dial that can actually go to 11!"

$499 | AU.MSI.COM

MSI MEG Z390 Ace; Intel Z390 Chipset; Socket 1151; Support for 8th & 9th generation Intel Core Processors; 3x M.2; 6x SATA; up to 8x USB 3.1 Gen 2, up to 4x USB 3.1 Gen 1, up to 8x USB 2.0; 802.11 a/b/g/n/ac Wi-Fi, Killer E2500 Gigabit LAN; Realtek ALC1220 7.1 Channel High Definition Audio; ATX Form Factor

MSI Meg Z390 Ace

MSI aced the looks.

MSI is also changing its branding by simplifying its gaming motherboard naming scheme. The high end is now known as the MEG series (MSI Enthusiast Gaming), then there's MAG (MSI Arsenal Gaming) and finally MPG (MSI Performance Gaming). We have the MEG Z390 Ace on hand. There's no doubt this is a high end board and it really does look terrific.

At this price, you'd expect some serious hardware. The PWM is a quality 12+1 phase system cooled by chunky metal PWM heatsinks linked by heatpipes. There's also dual eight pin power connectors so there's no doubt the board is built to take some overclocking punishment. One of the first things to catch your eye is the dial at the bottom right of the board. This is an automatic overclocking dial that can actually go to 11! We tested a couple of the lower speed modes which worked well, but the higher speed modes are *very* cooling and CPU dependent. If you're pushing to 5GHz and beyond, it's still better to do it manually, though a quick one touch OC is a nice little addition.

One of the lovely looking little things is the infinity display adjacent to the I/O shield. You can set RGB colours and effects that have a 3D depth effect.

MSI has equipped the Z390 Ace with Killer Network's E2500 Gigabit LAN controller, the lone board of the test not to be using Intel. Killer NICs sometimes come in for some criticism, but this is largely unfounded these days thanks to a lightweight .inf install and automatic Windows detection. MSI also use the latest Intel 1.73Gbps Wi-Fi controller. As we noted with the Aorus Master, it would be nice to see boards at this price start to adopt 2.5Gbps+ LAN.

The I/O area features an integrated shield and has all the ports we expect. There's a strong complement of USB ports, with six USB 3.1 ports including a Type-A and four USB 2.0 ports. The rest is as expected, with CMOS clear and BIOS flashback buttons complementing the antenna ports, LAN and audio including S/PDIF. The MSI is the only board in the test to completely omit display outputs, so you will not be able to use the CPU's integrated graphics.

The MSI UEFI BIOS implementation remains excellent. It's easy to navigate and logically laid out, both for the novice user and those looking to deep dive into more esoteric settings. We had no problems setting our RAM to DDR4-3866 and running the CPU at 5.1GHz, all within about 60 seconds.

The MSI performed as expected. We noted it was strong at CPU and memory related tasks.

MSI has produced a gorgeous motherboard that oozes appeal. It's a very user friendly board, and is a solid choice for the heart of your system.

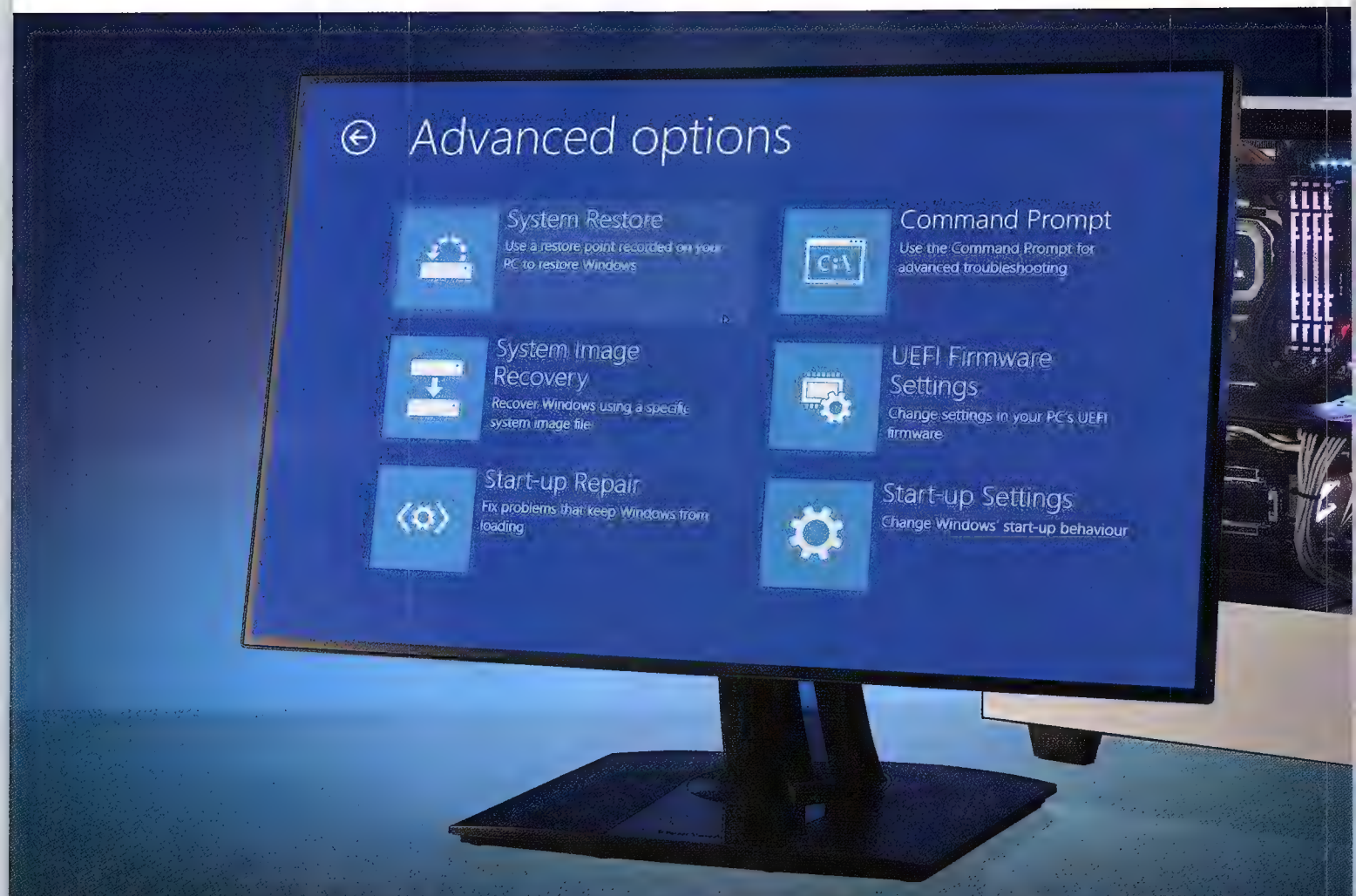
Verdict

MSI's Z390 Ace is a well-rounded and user friendly board that offers great looks and a competitive price.

★★★★½

LABS BENCHMARK RESULTS

3DMARK FIRESTRIKE - SCORE	MIDDLE EARTH: SHADOW OF WAR - 1080P, LOW, AVG FPS	GHOST RECON: WILDLANDS - 1080P, LOW, AVG FPS	X264 FHD VIDEO ENCODING - FPS	CINEBENCH 15 MULTI THREAD SCORE	CINEBENCH 15 SINGLE THREAD SCORE	7ZIP MILLION INSTRUCTION PER SECOND	AS-SSD - SCORE
22997	221	188.62	54.33	1530	209	41285	4476


Advanced options
System Restore
Use a restore point recorded on your PC to restore Windows
Command Prompt
Use the Command Prompt for advanced troubleshooting
System Image Recovery
Recover Windows using a specific system image file
UEFI Firmware Settings
Change settings in your PC's UEFI firmware
Start-up Repair
Fix problems that keep Windows from loading
Start-up Settings
Change Windows' start-up behaviour

WINDOWS 10 DIY REPAIR GUIDE

MAKE YOUR PC RUN LIKE NEW AGAIN • FIND & FIX WINDOWS' MOST ANNOYING PROBLEMS • **TAKE CONTROL OF WINDOWS UPDATE** • OPTIMISE YOUR LAPTOP & DESKTOP

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GAMING LAPTOP MASTERCLASS

APC shows you how to get more from your gaming laptop.

PAGE 60

LAPTOPS WITH GAME

This year's gaming laptops are slimmer and sleeker than ever, but do these cuts come at the cost of performance?

GAMING LAPTOP MASTERCLASS

Chris Szewczyk shows you how to get more from your gaming laptop.

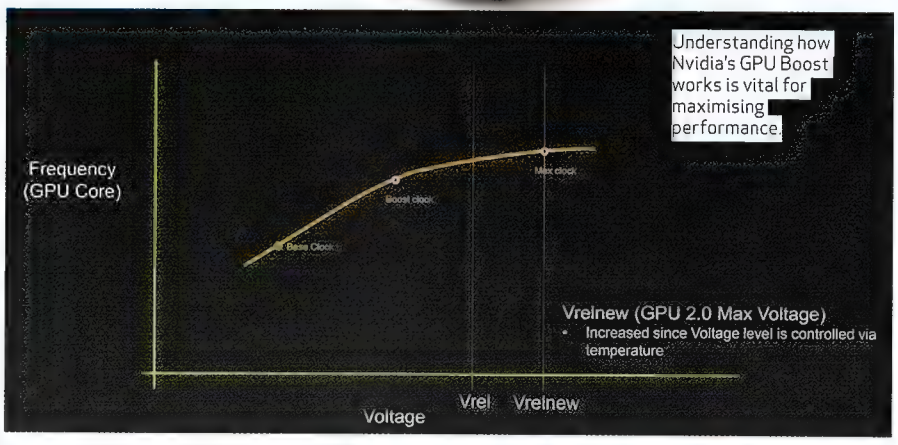
So, you've just taken delivery of your brand new gaming laptop. You've installed a couple of your favourite games and you can't wipe the grin off of your face as you load one of them up for the first time. What if your frame rate is not quite what you expected it be though? Fear not. There are a tonne of things you can do to help you reach that FPS level needed for smooth gameplay.

We'll go over a range of topics, aimed at helping you understand some of the basics before taking a look at key applications and settings. The goal is to have your laptop humming along with some sim-ple, easy to use methods and tools.

GAMING LAPTOPS ARE DOMINATED BY A KEY CHARACTERISTIC: TEMPERATURES

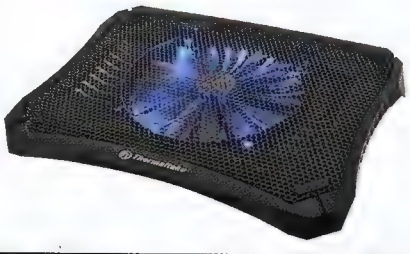
Firstly, it's important to understand one of the basic factors influencing a laptop: temperatures. Laptops have inherently inferior cooling when compared to a desktop. You just can't pack large heatsinks and fans into a laptop form factor. Modern hardware is more able than ever to adjust itself based on thermal conditions. All the tweaking in the world won't be able to overcome the loss of hundreds of MHz of clock speed due to excess heat.

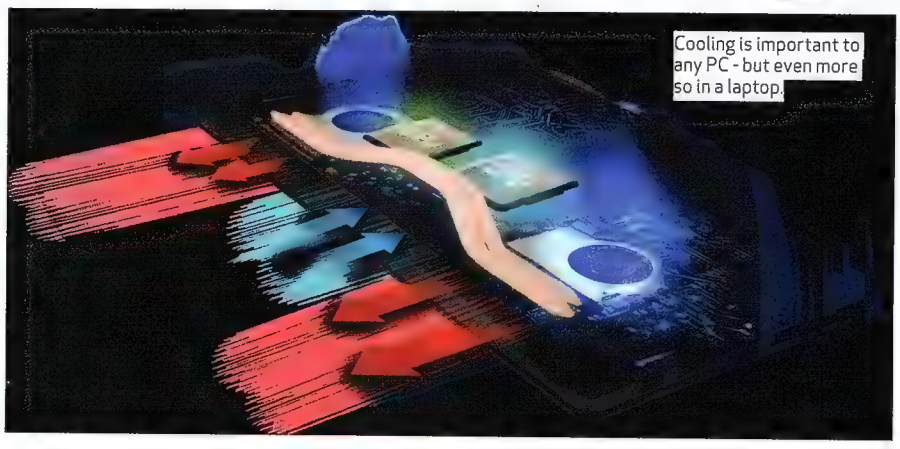
That last point is something to be acutely aware of. Nvidia GPUs come with an automatic dynamic clock speed adjustment function called GPU Boost. Outside of manual overclocking, it's the most important influence on your gaming performance. If your graphics card is running within its power and temperature budget, the GPU will overclock itself. This makes temperature monitoring doubly important. So, if you want to extract the maximum from your onboard graphics, don't be afraid to crank the fans up in order to keep the GPU at its highest possible clocks. (And use that headset to drown the noise out!) The difference between the base clock and a stable boost clock can run into the hundreds of MHz, and this can easily be the difference between an adequate gaming experience and a stuttering one.



Understanding how Nvidia's GPU Boost works is vital for maximising performance.

As GPU boost is such an important function, you may want to consider the use of a laptop cooling pad. It will help keep your GPU at higher boost clocks for longer. There's also the added benefit of lower noise levels. Large fans move more air than the tiny little screamers found in laptops.





Cooling is important to any PC - but even more so in a laptop.

Laptop hardware: a look under the hood

Hardware upgrades.

Laptop batteries simply lack the endurance to keep up with extended gaming sessions.

Modern games really benefit from more RAM.

One of the best things you can do for your laptop is upgrade to an SSD. Most modern gaming lap-tops come with some type of SSD, but older or cheaper models may not. Even an older system will gain an incredible and tangible speedup. You'll see massive improvements in overall system responsiveness and game startup times but you'll also largely overcome those annoying level loading screens and area transitions. After all, who wants to spend time looking at a spinning loading icon?

RAM is another upgrade option. You'll want to have 8GB as a minimum these days. Moving to 16GB will help with particularly demanding modern games, but it will also help if you frequently alt-tab out of games and into other applications.

Upgrading the graphics card is impossible on many laptops, but there are exceptions. Many laptop GPUs use the MXM PCIe interconnect, but unlike most desktop cards, many use significantly different form factors. The cooling assembly is likely to be tailored to suit the specific GPU, and changing to another could present a major obstacle. So, with a few exceptions, upgrading the GPU is pretty much off limits to most users.

> "Moving to 16GB will help with particularly demanding modern games, but it will also help if you frequently alt-tab out of games and into other applications."

GAMING ON THE BATTERY: CAN IT BE DONE?

Can you use your laptop and game with the battery? The easy answer is yes and no, but mostly no. GPUs suck a large amount of power. Some laptops with high powered GPUs throttle significantly when powered by the battery, dealing a major performance hit while only delivering a full charge gaming session measured in minutes. Even less powerful models might struggle to hit the one hour mark before running flat. If you've got access to a power point, use it.

If you do intend to game on the go, consider playing something that doesn't load the GPU so much. Today's e-sport titles don't require much grunt, so games like CS:GO or DOTA are not going to tax a laptop as much as Battlefield V at high settings.

If you really want to game on the go, Nvidia produce what are called Max-Q graphics processors. Several manufacturers offer Max-Q versions of the GTX 1060, 1070 and 1080. Simply put, they are down-clocked variants of those GPUs that run at lower frequencies, but with much improved power consumption. Recommending Max-Q laptops is difficult. They come with a hefty price premium and do give up quite a bit of gaming performance. Consider them only if battery life and low noise levels are at the top of your priority list, otherwise go for one of the standard non Max-Q variants.

TUF Z390M-PRO Gaming

ROG Maximus XI Hero (Wi-Fi)

ASUS Z390 MOTHERBOARDS AND 9TH GENERATION INTEL CPUS

POWER FOR EVERY WORKLOAD.

The release of Intel's 9th Generation Core processors raises the bar by offering up to eight cores and sixteen threads of processing horsepower. Power users, content creators, multi-taskers and gamers have an amazing array of new processors to choose from, and to extract the most from them, Asus is ready with a new family of Z390 motherboards.

Whether you're a hardcore overclocker looking to tweak your way to records, a gamer striving to dominate the battlefield, a professional needing rock solid reliability, or some combination of the above, Asus has a motherboard to suit you.

GET THE MOST FROM YOUR 9TH GENERATION SYSTEM

Asus makes overclocking easier and more seamless than ever thanks to AI Overclocking. When paired with a K-series 9th generation processor, AI overclocking uses an algorithm to monitor temperatures, fan speeds and power draw. It even rates the quality of your individual CPU and adjusts to changes in dust buildup and seasonal temperature variations to provide automatic overclocking without having to tweak everything yourself.

DDR4 memory speeds continue to increase. DDR4-4000 and higher modules are becoming increasingly widespread, and this requires some serious engineering to properly enable. Asus is renowned for its memory support and compatibility and so Asus Z390 motherboards have undergone a complete redesign making them more capable of running the highest memory speeds, even with all slots populated.

ASUS AURA SYNC: PCS THAT DEMAND TO BE SEEN

There's no better way to personalise your system than with adjustable RGB lighting. Thanks to Asus Aura Sync, controlling the colours and effects of your system is just a matter of a few mouse clicks. Asus partners with a wide range of component manufacturers, enabling consistent illumination of your PC, just the way you want it. Not everyone wants their PC to light up the night though, so Asus motherboards come with a stealth mode, which disables RGB lighting and secondary LEDs for a more discrete build.

Asus Z390 motherboards also come with headers for additional RGB strips including the addressable headers of most ROG models. Even the entry level Z390-P has an RGB header.

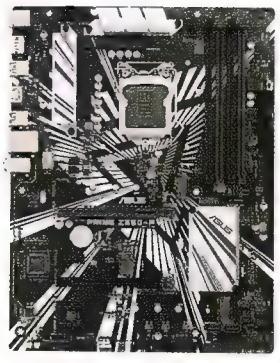
NEXT LEVEL CONNECTIVITY

Asus Z390 motherboards offer more USB ports and networking features than ever, including 5G LAN support for the Maximus XI Extreme and Formula. Select boards also make use of 160MHz 802.11ac Wave 2 WiFi, providing up to 1.73Gbps connectivity plus BT 5.0. Next generation networking is here.

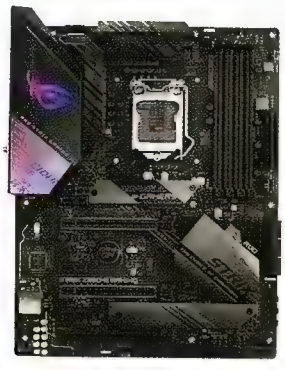
All Asus motherboards come with at least two M.2 SSD slots, meaning even entry level boards can make use of super speed NVMe technology.

In partnership with selected memory manufacturers, Asus has developed a new Double Capacity DIMM standard. Asus ROG and ROG Strix Z390 motherboards support this standard meaning it's possible to have up to 64GB of memory packed into just two memory modules. This is perfect for ITX motherboards or the likes of the Strix Z390-I Gaming which can now utilize the platform's maximum supported amount of memory at high frequencies.

The new Asus Prime Z390-A



Striking visuals mark the Asus Prime Z390-P



The premium performance ROG Strix Z390-E Gaming

The new Asus TUF Z390M-PRO Gaming, one of five new TUF boards

ROG MOTHERBOARDS SET THE STANDARD YET AGAIN

Asus Republic of Gamers motherboards continue to be the gold standard for enthusiast class motherboards. Gamers and overclockers all over the world continue to extol the virtues of ROG products year after year.

The Maximus XI Extreme is the ultimate dream motherboard, packed with innovative features while the Maximus XI Formula is tailored to suit modders and watercooling enthusiasts. The Maximus XI Apex is an unrivalled overclocking motherboard, stacked with tweaking options and class leading memory performance. The Maximus IX Gene is the ultimate mATX motherboard, perfect for a small form factor build while giving up nothing in terms of refinement or capabilities. Then there's the Maximus XI Hero. It's unmistakably ROG but in a more value oriented package.

ROG STRIX MOTHERBOARDS ARE PERFECT FOR THE DISCERNING GAMER

If you don't need super high end expense adding features, but still demand Asus Gaming know how, then the ROG Strix series is for you. Strix motherboards deliver everything you need to get the most out of your game.

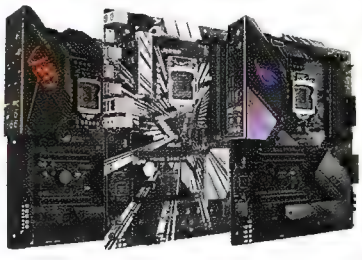
For full-sized systems, the Strix Z390-E and Strix Z390-F Gaming deliver all the key features you need in balanced packages while the Z390-H Gaming is the most affordable way to join the ranks of the ROG club, without giving up anything in terms of performance or reliability.

If you're a small form factor junkie, then it doesn't get much better than the Strix Z390-I Gaming. Asus engineers have worked wonders to pack features and components into this tiny ITX motherboard. You still get dual M.2 drive slots and the ability to pack in up to 64GB of memory thanks to Double Capacity DIMM support.

TUF GAMING: BULLETPROOF RELIABILITY AND COMPATIBILITY

The Asus TUF series is a unique industry initiative that promises compatibility and reliability along with a consistent aesthetic. TUF Alliance memory, coolers and cases are all widely available. This gives you peace of mind that your Asus build is battle tested. Building a reliable PC has never been easier.

There are five different TUF models to choose from. All feature military grade components and have upgraded VRM's that are engineered to easily handle the demands of 9th generation processors. Quality and durability go hand in hand with the Asus TUF series.



'All Asus motherboards come with at least two M.2 SSD slots, meaning even entry level boards can make use of super speed NVMe technology.'

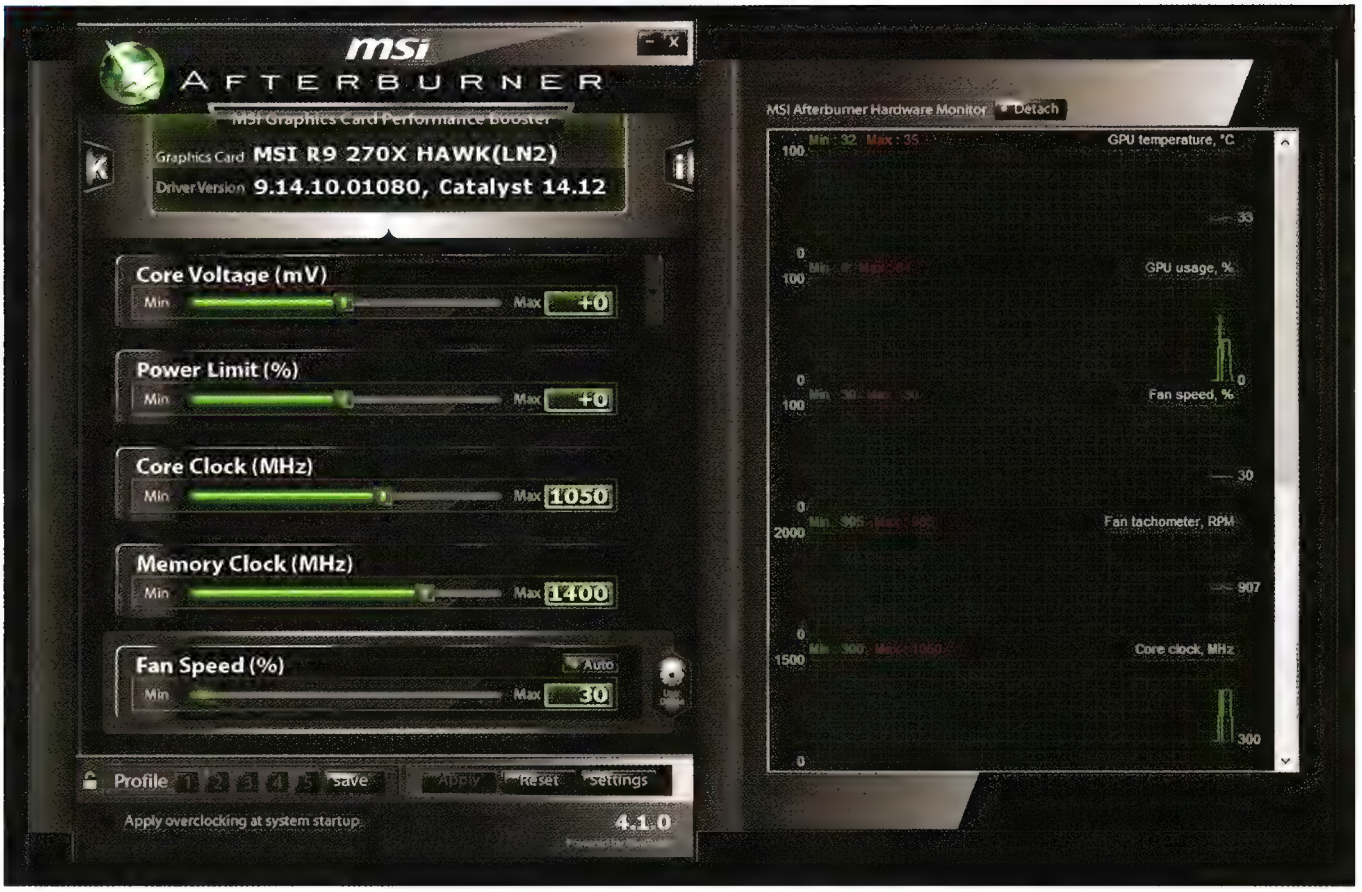
ASUS PRIME MOTHERBOARDS: BALANCED FEATURES AND PERFORMANCE

Asus Prime motherboards deliver a great balance of features and performance with attractive pricing. With a Prime motherboard, there's nothing stopping you from building a top specification enthusiast build. You still get all the key platform features and expansion options without wasting money on un-needed expensive enthusiast features. A board such as the Prime Z390-P or Prime Z390M-PLUS are solid choices for you Z390 and 9th Generation build, and you'll save some dollars in the process.

THE WS Z390 PRO IS A WORKSTATION COMPUTING POWERHOUSE

Eight core Intel processors have processing power that was the exclusive domain of high end platforms just a couple of years ago. If you're geared towards productivity instead of play, then the Asus Z390 WS is for you. Do you need the sheer power of quad GPUs for rendering or 3D modelling? Check. How about M.2 and U.2 ports for enterprise class storage? Asus has got you covered.

The WS Z390 Pro is decked out with up to sixteen USB ports plus teaming capable dual Intel Gigabit LAN. Workstation users and even gamers looking to build multi GPU systems should take a look at the WS Pro for unmatched expansion and connectivity capabilities.



An essential tool if you want to tweak the performance of your GPU.

Essential apps and tools

Say no to bloatware

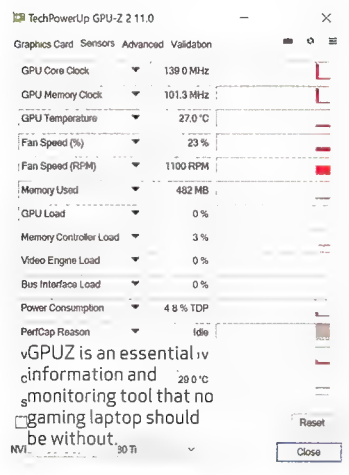
The internet is full of applications that promise to supplement or enhance your gameplay. Some of them are complete rubbish, while others are essential. We've chosen some great applications that are essential for any gaming system.

One of the best applications in the business is GPU-Z. It's a lightweight app that provides basic in-formation about the GPU. It also has a simple and accurate 'sensors' tab which provides useful in-formation such as the GPU clock speeds and temperatures of both the CPU and GPU.

MSI's Afterburner is a complete overclocking and monitoring tool that's suitable for all Nvidia and AMD graphics processors, not just MSI's. While overclocking a laptop GPU is possible, temperature monitoring is critically important and it should not be attempted by an inexperienced user.

When a new game comes out, it's vitally important that you install the latest graphics driver. High profile games in particular are often accompanied by a new driver on launch day. These 'game ready' drivers feature a raft of optimisations that can make the difference between butter smooth gameplay and a buggy, crashing slideshow. Display Driver Uninstaller (DDU) is a driver removal utility that completely uninstalls graphics card drivers and all the other junk they can otherwise leave behind. This should be run every time you install a new graphics driver.

Malware, spyware and viruses are all too common, running in the background and slowing down your system. Practising safe online activity is critical to maintaining a healthy system, not just for optimising your gaming sessions, but also for security, particularly when it comes to your passwords and protecting your personal and financial information.


TechPowerUp GPU-Z 2.11.0
Graphics Card Sensors Advanced Validation
GPU Core Clock 139.0 MHz
GPU Memory Clock 101.3 MHz
GPU Temperature 27.0 °C
Fan Speed (%) 23 %
Fan Speed (RPM) 1100 RPM
Memory Used 482 MB
GPU Load 0 %
Memory Controller Load 3 %
Video Engine Load 0 %
Bus Interface Load 0 %
Power Consumption 4.8 % TDP
PerfCap Reason Idle
Reset
Close

vGPUZ is an essential information and monitoring tool that no gaming laptop should be without

Running a virus and malware scan on your system can clean up that junk so it doesn't run in the background. The Windows Defender Security Centre does a decent enough job but it's generally not up to the standard of a dedicated security suite. AV applications are resource hogs though, so if you practice safe surfing (consider a no-script browser extension) and stay away from those email at-tachments then you should be safe. If you do happen to be infected by pesky malware, a tool such as Malwarebytes is a good way to remove it.

What about the manufacturers own 'gaming' apps? Evaluating these can be a bit tricky, as many of these apps could be considered bloatware. Some of them can be quite useful with everything from monitoring, RGB control and profile support to video and audio controls. Have a look at what they offer before installing or uninstalling them. Steer clear of anything that also wants to install some-thing like a 30 day Norton trial or an Ask toolbar... ewww.

Tweaking windows for optimal gaming performance

Get rid of preinstalled junk.

If you've just taken delivery of your new gaming laptop, the chances are there is a lot of useless pre-installed software, that is, well, crap.

It's also likely that your system has a bunch of miscellaneous programs running in the background. Pre-installed bloatware, or programs that got installed along with some other software take up valuable system resources and uninstalling these, or at least disabling them at startup will free up RAM and CPU cycles, leaving more resources for your game.

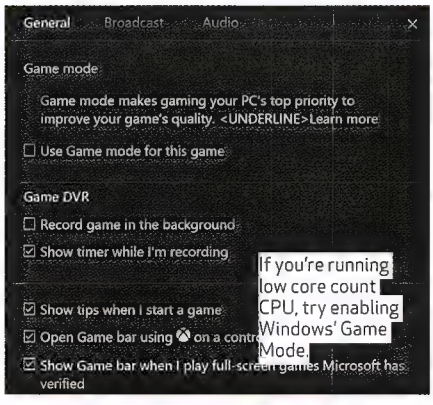
Firstly, head to the Control Panel, then apps and features. If there are apps there you know you will never use, then simply uninstall them. You might be surprised about just how much space you'll free up, particularly if you're using a space limited SSD. Note that you should not to delete any important programs, such as software related to windows itself. If you're unsure, a bit of google-fu will tell you if an app is important or not.

After cleaning out the crap, the next step is to check if the leftover apps are scheduled to run on startup. If you find yourself frequently using a lot of them, then that's fine, but if gaming is your main focus, do you need to have Skype or Spotify or BitTorrent starting up? Probably not, though you'll know which apps you frequently use or not.

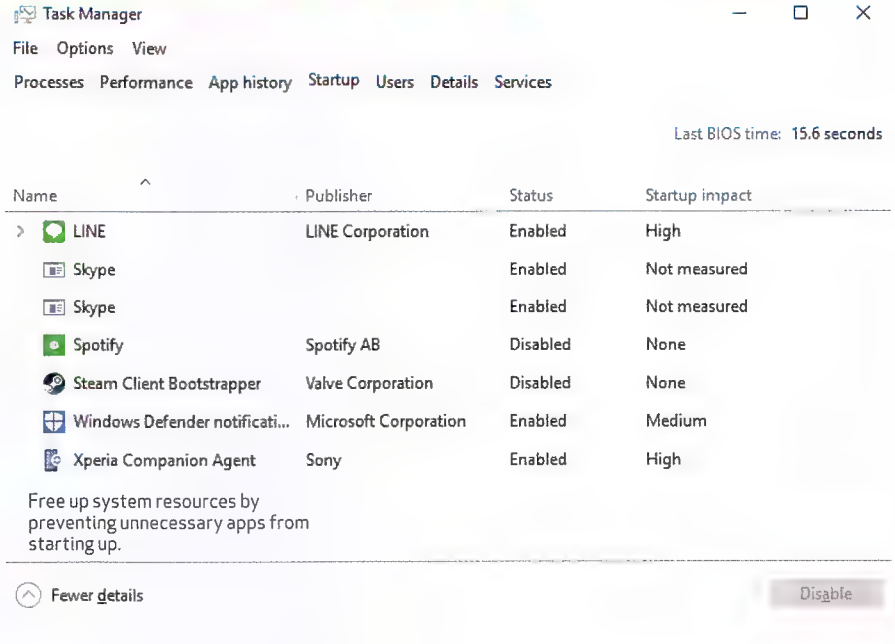
To access the startup list, Open Task Manager by pressing Ctrl+Shift+Esc and select the Startup tab. Simply select the desired (or undesired) program and click the Disable option in the lower right cor-ner. Of course, it is perfectly fine to have a program start itself if you'd launch it immediately anyway.

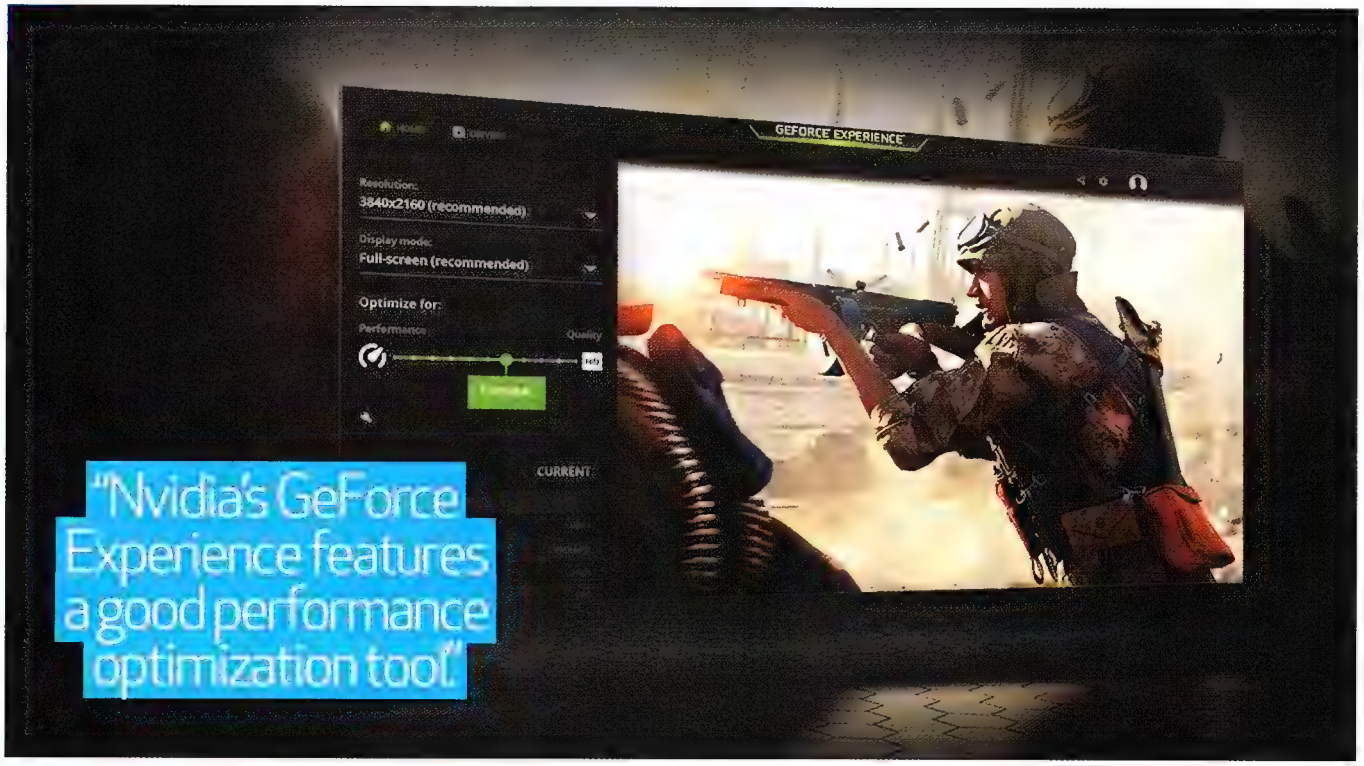
ENABLE WINDOWS 10 GAME MODE

Newer Windows builds come with a 'Game Mode'. When you launch a game, pressing Win+G brings up the Windows Game Bar. Game mode assigns the game to specific cores. If you have a lower end CPU, say a dual core, dedicating a core to the game can provide benefits, particularly with minimum frame rates. With the Windows October update installed, it also disables automatic Windows up-dates while in game (yes!). Users with higher core counts won't see too many benefits, if any, but it's worth playing around with to see if improves your gaming experience with your specific hardware configuration.


General
Broadcast
Audio
Game mode
Game mode makes gaming your PC's top priority to improve your game's quality. <UNDERLINE>Learn more
Use Game mode for this game
Game DVR
Record game in the background
Show timer while I'm recording
Show tips when I start a game
Open Game bar using on a contr
Show Game bar when I play full-screen games Microsoft has verified
If you're running low core count CPU, try enabling Windows' Game Mode.

> "If you have a lower end CPU, say a dual core, dedicating a core to the game can provide benefits, particularly with minimum frame rates."





Optimising your graphics settings

Tweak it.

Most games attempt to automatically set your graphics settings. This may take the form of a 'auto-detect' or it may set the quality to the likes of 'low', 'high' or 'ultra' etc. A hardcore gamer will prob-ably end up tweaking the individual settings manually, but for the less experienced user, there are plenty of ways to optimize a specific game to run as well as it can on your system.

Many users will consider Nvidia's Geforce experience and AMD's Gaming Evolved apps to be unnecessary bloatware, but they do have pretty decent game optimisation tools. These apps will show the officially supported games, however, you can manually add them as well. After pressing Optimize in the Nvidia or AMD tools, you'll be able to see difference between your current game settings compared against and the ones Nvidia or AMD recommend as optimal. There's also sliders in both apps that lets you adjust your settings for performance or quality.

'Can it play Crysis?' is a meme that continues to this day. The same concept applies to many newer highly intensive games. While the goal is always to game at the highest resolution and settings, of course this is not going to be possible. Eye candy should be regarded as secondary to actual quality game play. If you're busy engaging enemies or trying to trim a tenth off of a lap time, are you really going to notice a slightly lower graphical detail or a tree with a few less pixels? Probably not, so don't be afraid to lower settings a notch or two if it helps you to achieve a smooth gaming experience. You want to be immersed in your gameplay, not distracted by annoying FPS drops.

Some settings are particularly resource hungry. If you're struggling a bit to maintain a decent FPS level, disabling some of the taxing options like MSAA, supersampling , draw distance or vendor specific settings like Nvidia's Hairworks. This can deliver substantial performance increases depending on the game.

Nvidia's Geforce Experience application comes with an optional battery boost setting. For example, if your game typically runs at something like 60-90 FPS, you can lower it to 30 or 40 FPS which takes a lot of the load off of the GPU, prolonging battery life. While battery boost can produce some significant improvements in the range of 50%+ in some circumstances, you're always better off plugged in wherever possible.

Don't forget, if adjusting your graphical detail levels still delivers sub optimal gameplay, you can always drop the resolution a notch. You'll get a nice FPS jump.

Keeping your laptop hardwired to the network can boost performance.

Miscellaneous tips and tweaks

Push your machine.

Let's finish off with some simple tips that will help you to maximise your gameplay experience.

If you're gaming online, use an Ethernet network connection wherever possible. Wi-Fi is convenient and mostly adequate but using it leads to an increased likelihood of random packet loss and latency spikes.

Use a simple FPS monitoring tool such as FRAPS or enable the Steam FPS counter (Steam Menu > Settings > In-Game). If you're looking to hit 60FPS or even 120FPS with a high spec display, keeping an eye on the frames per second will indicate if you need to tweak your graphical settings to reach your desired figure, hopefully without having to drop the resolution!

> "Try to keep your environment as clean as possible. Try to keep your pets away too, though that's probably easier said than done!"

Dust is your enemy! It gets into your system and can obviously seriously hinder the cooling perfor-mance of your laptop, leading to throttling and reduced FPS. Try to keep your environment as clean as possible. Try to keep your pets away too, though that's probably easier said than done!

Lastly, we'll reiterate what we covered on the first page. Temperature control is vital, not just from a longevity point of view, but also performance. A cool laptop is a better performing laptop. You don't want to be throwing away free performance because your laptop is running a bit hot. With summer coming up fast, keep an eye on your temps!

ENOUGH READING. MORE GAMING!

Now that you've gotten your hands on your dream machine, take some time before firing up your first game (easier said than done, we know!). Taking the time to maximise your performance and optimize your settings will lead to a better gaming experience. We all want that butter smooth gameplay. In the end a few simple tweaks and bit of knowledge will help you reach that goal. ■

THE 2018 GAMING LAPTOP ROUNDUP

Laptops with game

This year's gaming laptops are slimmer and sleeker than ever, but do these cuts come at the cost of performance? Joel Burgess

2018 has been another big year for laptop development with chip manufacturers funnelling even more resources into making compact devices for ultra modern consumers. Nvidia announced its Max-Q laptop GPU range back in 2017, but the slightly curbed output performance has meant that they were slower to be adopted than many GPU updates in the past. That said, they're now in full swing with early 2018 builds shifting the majority of available gaming laptop GPUs to Max-Q.

This trend means that laptops require fewer heat pipes and less intensive fan structures, which has the overall effect of slimming everything down considerably. Max-Q comes at a 10% or so peak performance cost to configurations that maintain the same tier GPU, but the reduced power and space requirements means that, in many instances, this year's gaming laptops can level up the GPU from last year's top of the line configurations. If you only care about the FPS then there isn't much to get excited about, but if you find the potential to game on something that isn't a chore to carry around appealing, then 2018 has been one of the best years yet.

What's perhaps even more dramatic than Max-Q for the gaming laptop space is the shift from 4 cores to 6 on Intel's top mainstream Core i7 laptop chip. Not only did this chip get a reasonable clock boost, but the extra two cores adds around 35% to raw processing performance of all the updated gaming models we tested from their 2017 predecessors. While there's still plenty of progress in the desktop space keeping laptops from shrinking the performance gap drastically, upping the options to 6 cores and 12 threads has had a considerable impact.

We didn't cover any of the gaming motherships here, but it's also worth noting that 2018 was the first year Intel offered an overclockable Intel i9 CPU in its laptop range. The performance boosts were moderate at best, with many laptops simply not having the thermal architecture to push the chip much further without them overheating and seeing their Turbo speed limited, but it is a novel feature that shows there's been a lot of love for the entire range of gaming laptops this year.

SSDs have continued to come down in price with plenty of affordable gaming laptops offering 256GB or even 512GB of primary solid state storage. NVMe has also continued to get faster with internal drives writing at over 2000MB/s, and maintaining absurd read speeds of over 3000MB/s. We've even seen the first Optane drives appearing on gaming laptop spec sheets.

Other than this we've seen vendors really lean into 120 and 140Hz screens, keeping the 4K offerings for the more professional gaming ultrabooks. This direction makes a lot more sense, since it prioritises frame rates and higher graphical settings over higher resolutions on screens that, arguably, are a little too small to benefit from 4K when gaming, and allows better matching of GPUs.

To round it out, we've even seen AMD throw its hat in the ring with a new integrated GPU that works in conjunction with an Intel Core i7-8705G, for graphical performance that's on par with a Nvidia GTX 1050 and comes in a 2-in-1 form factor. So there's a heap to like about the 2018 gaming laptop offering.

FROM $1,999 | WWW.ACER.COM

Acer Predator Helios 300

Is Acer's sun-named laptop a little too hot?

Acer described its new Helios range as having a radical new design, but from what you can see, the Predator Helios 300 is rather dated. Wrapping the laptop is a well worn brushed metal finish, relieved by the odd speed stripe and a cheap plastic undercarriage (which trades out weight for style). And while the keyboard and number pad look fine, the rounded keys and red colouring don't offer much in the way of uniqueness. For some reason Acer has decided to bunch all the ventilation to one side of the laptop and has blocked off a whole half of the rear vent, which means there's going to be crossover in CPU and GPU thermals. We recorded 100°C peaks throughout our testing, so you should expect some thermal throttling when gaming and potentially accelerated wear over time. The Intel Core i7-8750H CPU managed to get a score of 1039 in the Cinebench Multi-threaded CPU test, which puts it above half of the units tested here. Add 16GB of RAM to that and throw in a Nvidia GTX 1060 and you get respectable *Ghost Recon: Wildlands* average frame rates of 35.5fps (Ultra 1080p). Battery life was two hours and 19 minutes under strenuous home usage conditions, which isn't great, but is pretty common in the gaming laptop space. The entry level unit comes with a 128GB PCIe-connected SSD and a 1TB HDD, but you can bump up the SSD storage to 256GB or even 512GB if need be. While there are options for a 15.6-inch 144Hz IPS display at 1920 by 1080 pixel resolution in the States, it seems we're stuck with only 60Hz options locally.

Verdict

The Helios 300 offers good specs for the price, but the thermal management could be better.

★★★½☆

Windows 10 Home 64-bit; 15.6-inch IPS display @ 1920 x 1080 pixel resolution; Intel Core i7-8750H CPU; Nvidia GeForce GTX 1060 GPU; 16GB RAM; 128, 256GB or 512GB NVMe SSD, 1 or 2TB HDD, 48.9Wh Li-Ion battery (2:19 hours PCMark 8 Home test), 39 x 26.6 x 2.7cm, 2.57kg.

FROM $2,694 | WWW.ACER.COM

Acer Predator Helios 500

Is this oldschool gaming rig predator or prey?

With the emergence of hexa-core laptop CPUs and Nvidia's power-conserving Max-Q GPUs, modern gaming laptops have far less thermal pressures and, as a result, are far more compact and discrete than their predecessors... well, at least most of them are. The 3.8kg Acer Predator Helios 500 is no such beast. It's not only more than a kilo heavier than its closest brethren, but it's also over a centimetre thicker than the next thickest device here (the Predator Helios 300) and there's even a few additional centimeters on each edge of the footprint (which makes sense given it's the only 17.5-inch rig in the roundup). This big IPS display is also faster than most with a 144Hz refresh rate and the bonus G-Sync compatibility means it'll play nice with the device's Nvidia GeForce GTX 1070 GPU. This graphics card is supported by an Intel Core i7-8750H CPU and 16GB of RAM for what seems like pretty standard rollout against the other gaming rigs here. As expected, the Helios 500 topped the Cinebench Single-Core, but it was by only one point and while it excelled at the PCMark 8 Home benchmark, it hit a few stumbling blocks on the work tasks. If we take a look at graphical performance however, the Predator Helios 500 is the clear winner. Beating the Razer Blade 15 (2018) in 3DMark's Fire Strike benchmark by 13%, the Helios 500 managed to translate this into considerable real world gaming boosts of between 8 and 25% more than the next closest contenders, with 51.9 fps averages on *Ghost Recon: Wildlands'* Ultra 1080p benchmark.

Verdict

A full sized gaming laptop that prioritises performance over price and portability.

★★★★☆

Windows 10 Home 64-bit, 17.3-inch 144Hz IPS display @ 1920 x 1080 pixel resolution, Intel Core i7-8750H CPU, Nvidia GeForce GTX 1070 GPU, 16GB or 32GB of RAM, 256GB or 512GB SATA SSD, 1TB or 2TB HDD, 74Wh Li-Ion battery (1:58 hours PCMark 8), 42.8 x 29.8 x 3.9cm, 3.8kg.

FX504GE, $1,799; FX504GD, $1,499 | SHOP.ASUS.COM/AU

Asus TUF FX504

Will this be the last laptop standing?

Asus has brought its TUF naming convention to an all new laptop range that it hopes will be sturdier, more reliable and have a longer lifespan than a "standard laptop" thanks to a few new integrated technologies. Alongside a new six-core CPU – which, in theory, will help spread processing loads and keep the system cooler – the TUF FX504 has a new Anti-Dust Cooling system to actively expel system-damaging dust before it can collect on fan blades and metal grills. A cutaway on the hinge-edge of the laptop shell creates space for a bigger fan vent that Asus claims offers 27% greater thermal dispersion over a conventional laptop. It's also got some neat design perks, like the inlet fan below the WASD key group that keeps your hand well ventilated during long gaming sessions, and the keyboard's reportedly twice as durable as the industry standard. The TUF FX504 hasn't scrimped on processing power, with its Intel Core i7-8750H CPU and 16GB RAM combo scoring relatively well in all benchmarks. The Nvidia GeForce GTX 1050 Ti GPU also hits the sweet spot when it comes to budget gaming, with performance sitting almost perfectly between the GTX 1050 and the GTX 1060, giving a playable 30fps plus on modern titles like *The Division* and *Far Cry Primal* at Ultra/1080p settings. There's a less-expensive FX504GD model with a GTX 1050 GPU and a 128GB SSD connected via PCIe for 1,500MB/s read speeds, but the model we tested had a 256GB SATA SSD. Both also offer an additional TB of HDD storage and have a woeful 1:28 hour movie playback battery life.

Verdict

A well constructed budget gaming laptop that looks like it's playing the long game.

★★★★☆

Windows 10 pro 64-bit, 15.6-inch TN or IPS display @1920 x 1080 pixel resolution, Intel Core i7-8750H CPU, Nvidia GeForce GTX 1050 or 1050 Ti, 16GB RAM, 128GB PCIe or 256GB SATA 3 SSD, 1TB HDD or 1TB Seagate FireCuda SSHD, 45Wh Li-ion battery (1:28 hours 1080p movie playback), 38.4 x 26.2 x 2.5cm, 2.3kg.

FROM $1,799, TESTED $2,199 | WWW.DELL.COM

Dell G5 15

A mid-range gaming laptop with plenty of G-force.

The Dell G5 15 isn't going to be changing anyone's expectations on what a gaming laptop should be, but it is an incremental improvement for a good value gaming laptop. As a budget conscious gaming rig, it isn't the sleekest PC we've seen, but the horizontal front and back edge grills look like the radiators, vents and rear windows on a 1980s Ferrari or DeLorean – which is a nice touch. The full size keyboard and trackpad are a little too shallow and coarse, for our liking and the 15.6-inch IPS display is a little dull, but they all get the job done.

The i5 model was definitely better value at the time of writing (Dell's online store had a 15% sale on the entry level device), but both were priced around what we'd expect from their spec sheet (with a 10% new device price bump). The model we tested came with a powerful Intel Core i7-8750H CPU, 16GB of RAM, a Nvidia GeForce GTX 1060 (Max-Q) GPU and a 256GB SSD/1TB HDD storage combo. This is a well balanced configuration for an entry level gaming PC so it's not surprising that it hit respectable scores somewhere in the middle of the pack on Cinebench's CPU tests and PCMark 8's Home and Work benchmarks. When it comes to gaming the device was able to get playable average frame rates of 35.9fps on Ultra 1080p settings in modern titles like *Ghost Recon Wildlands*. The G5 15 is a solid gaming device, but you can find similar specced rigs for 10% less pretty easily.

Verdict

A well constructed mid-range gaming laptop that performs well but needs to be a little cheaper.

★★★½☆

Windows 10 Home 64-bit; 15.6-inch IPS display @ 1920 x 1080 pixel display; Intel Core i7-8750H CPU; Nvidia GTX 1060 (Max-Q) GPU; 16GB RAM; 256GB Micron SATA 3 SSD; 1TB HDD; 56Wh Li-Ion battery (4:43hr PCMark 8 Home (acc.)); 38.9 x 27.5 x 2.5cm; 2.83kg.

FROM $3,399 | WWW.DELL.COM/EN-AU

Dell XPS 15 2-in-1

Flipping the page on gaming laptops.

After many years alone on the frontier the Surface Book 2 finally has a some serious competition in Dell's latest XPS 15 2-in-1. The device features a new Intel Core i7-8705G CPU that integrates a Radeon RX Vega M GPU from AMD for entry level gaming laptop performance in a super compact form factor. The starting price for a FullHD Dell XPS 15 2-in-1 is an eye watering RRP of $3399, but Dell's web store had it on sale for $2,899 at the time of writing. This configuration comes with 8GB of RAM, but you can bump this to 16GB and slap on a 15.6-inch 4K Infinity Edge display for a RRP of $3,899 ($3,314 on 15% sale). The almost edge to edge display looks amazing and the premium looking hinge design offers stability and flexibility to the convertible. The keys are a little shallow, but the keyboard's maglev butterfly switches offer good spacing and resistance, and the trackpad has the perfect balance of glide and precision. While this unit tops performance in the 2-in-1 category, it's got tougher competition in the gaming laptop category, coming in around the bottom of the pack in raw CPU performance and general work tasks. The AMD GPU gets better graphical performance than a Nvidia GTX 1050, so this tablet can run older games on 1080p Ultra settings at 40fps plus and will even get averages above 30fps on titles like *Far Cry Primal* and *Ghost Recon: Wildlands* if you curb those graphics settings to High/ Very High 1080p. Battery life is good for a gaming laptop but isn't great overall at 2:46 hours under strenuous home usage conditions.

Verdict

A surprisingly powerful hybrid that is more than capable of entry-level gaming.

★★★★½

Windows 10 Pro 64-bit, 15.6 inch IPS touchscreen display @ 1920 x 1080 or 3840 x 2160 pixels display, Intel Core i7-8705G CPU, AMD Radeon RX Vega M GPU, 8GB or 16GB RAM, 512GB or 1TB NVMe PCIe SSD, 75Wh LiPo battery (5:11 hours video playback), 35.4 x 23.5 x 1.6cm, 2kg.

FROM $2,699 | WWW.GIGABYTE.COM/AU

Gigabyte Aero 15 (2018)

A gaming laptop with the air of professionality.

Confining a 15.6-inch Pantone colour-calibrated 144Hz screen, a full-sized keyboard, dedicated Nvidia GTX 1060 GPU and a generous 94Wh Li-Ion battery within a slim 35.6 x 25 x 1.9cm chassis, is an impressive feat of engineering. Add to this an Intel Core i7-8750 CPU, 16GB of RAM and a 512GB SATA SSD and the 2018 Aero 15 has an extremely impressive spec sheet for a device that weighs a little over 2kg. Squeezing all this into an ultrabook has led to some undesirable details like a below-screen webcam, and the keyboard is a little more cramped and off center than we'd like, but these are minor details in the scheme of things. While the Aero 15 has an RRP of $2,999 (on sale it's $2,699) you can upgrade to an Aero 15X with a GTX 1070 GPU and a PCIe connected SSD of the same size for $3,399 (sale $2,899) for specs that line up with MSI's GS65 Stealth. The Aero was still our highest performer in the Cinebench Multi-threaded benchmark, netting about 4% more than the Razer Blade 15, which came in second. While the Aero 15 has generous GPU power for a professional ultraportable, the Nvidia GeForce GTX 1060 model is middle-of-the-road when it comes to performance against today's gaming laptops. While it'll get around the 60fps mark for most games released before 2017 on Ultra 1080p settings, it only hits a 35fps average on *Ghost Recon: Wildlands*. That's 10% and 24% lower than the GTX 1070 GPUs get on the MSI GS65 and the Razer Blade 15, respectively. This is made up somewhat by an impressive 6:17 hour working battery life for general home tasks.

Verdict

A well rounded gaming ultrabook with an all day battery life and a reasonable price tag.

★★★★½

Windows 10 or Pro 64-Bit,15.6-inch FHD (1920 x 1080) 144Hz LED display (Pantone calibrated); Intel Core i7-8750H; Nvidia GeForce GTX 1060 or GTX 1070, 16GB DDR4; 512GB Crucial SATA 3 SSD or 512GB PCIe NVMe SSD; 35.6 x 25 x 1.8 cm; 2kg.

FORM $2,199 | WWW2.HP.COMCOMAUSTRALIASTORE/

HP Omen 15-dc0105TX

Is HP's latest gaming laptop a sign from the gods?

We haven't seen a case design we like as much as what's wrapped around the HP Omen 15 in a long time. Sure the 2.48kg device isn't gunning for an ultrabook position – it's a proper gaming laptop and it displays this prominently with a carbon fibre and brushed metal top casing that looks premium and powerful, without being vulgar. This continues to a textured undercarriage that makes a feature of the front edge speakers and underside fans – which are an important component in the device's overhauled thermal design. The full-sized keyboard extends from edge to edge, but the keys don't offer much resistance and the trackpad is tiny. Fortunately this is the only area that doesn't feel premium, since the Omen 15 is available with either a 15.6-inch Full HD 144Hz IPS display or a FullHD 60Hz IPS display with G-Sync. These premium screens were powered by an Intel Core i7-8750H CPU, 32GB of RAM and an Nvidia GTX 1070 GPU on our test unit. The components here are pretty modular, with HP offering Omen 15 rigs with a regular 1080p screen, 16GB of RAM and a GTX 1060 for an RRP starting at $2,199. The powerful components on our test unit didn't disappoint with the CPU topping the roundup with a score of 1145 in Cinebench's Multi-threaded CPU test and getting the highest score in the PCMark 8 Home benchmark. A GTX 1070 should be getting somewhere between 40-50 frames per second on *Ghost Recon: Wildlands* at 1080p Ultra, so the Omen 15's 42.5 fps average isn't outstanding, but it's about 17% better than the GTX 1060 scores here.

Verdict

A great looking gaming rig that offers solid performance for a fair price.

★★★★☆

Windows 10 home 64-bit, 15.6inch 60Hz IPS display @ 1920 x 1080 pixel resolution OR 15.6-inch 144Hz IPS display @ 1920 x 1080, Intel Core i7-8750H CPU, Nvidia GeForce GTX 1060 or 1070 GPU, 16GB or 32GB RAM, 128 GB, 256GB or 512GB NVMe SSD, 1TB HDD, 66Wh Li Ion battery (2:14 hours PCMark Home test), 36 x 26.3 x 2.6cm, 2.48kg.

FROM $1,749 | WWW2.HP.COM

HP Pavilion Gaming Laptop 15

An entry level gaming laptop that can get down to business.

HP pitches its Pavilion Gaming Laptops as more of an all-round device that was designed to be a powerful professional PC that includes enough grunt to give you the capacity for some lighter gaming. It's a really sensible concept and there'll be plenty of people who it appeals to, but it's also a tough sell in a way because the 'gaming ultrabook' space is flooded with vendor's flagship devices. The Pavilion Gaming 15 is half a kilo heavier than the lightest gaming ultrabook here, it's on average a centimetre wider and a centimetre deeper, and it's even 47% thicker (81mm) than the Razer Blade 15. That said, in isolation the case design has some nice angles, the keyboard is well spaced and offers ample resistance, and the trackpad is a nice size and relatively smooth. There is however, one big thing that the Pavilion Gaming 15 has on its gaming ultrabook friends ... price. Starting at $1,749 for a 15.6-inch IPS display, Intel Core i5-8300H CPU, 8GB of RAM and a Nvidia GTX 1050 GPU configuration, the range extends up to models with a 4K display, Intel Core i7-8750H CPU, 16GB of RAM and a Nvidia GeForce GTX 1050Ti GPU for $2,099. The model we tested had this FullHD screen i7 CPU, 16GB of RAM and a GTX 1050 GPU and was available exclusively from JB Hi-Fi for $1,868.30 at the time of writing. The CPU performs admirably, scoring within 5% of the three flagship ultrabooks here on PCMark 8's Home benchmark, but this is the only device here with a Nvidia GeForce GTX 1050, so expect a 28% performance drop from a GTX 1050 Ti for 1080p *Ghost Recon: Wildlands*.

Verdict

A great value professional offering that's versatile enough to be good for both work and play.

★★★★☆

Windows 10 Home 64-bit, 15.6-inch IPS display @1920 x 1080 pixel resolution, Intel Core i7-8750H CPU, Nvidia GeForce GTX 1050, 1050 Ti or 1060 GPU, 8GB or 16GB of RAM, a 128GB SATA or 256GB PCIe SSD, 1TB Seagate HDD, 52.6Wh Li-Ion battery (2:21 hours in PCMark 8 Home) 36.5 x 25.65 x 2.54cm, 2.17kg.

FROM $2,799 | AU.MSI.COM

MSI GS65 Stealth

MSI's new gaming ultrabook is dressed to impress.

MSI's Stealth laptops have traditionally carried the loud red-and-black colour scheme of the company's broader gaming line, but this year's GS65 Stealth Thin has matured considerably, wrapped in a sleek metal and gold-beveled unibody chassis and with a premium keyboard and trackpad combo. A speedy 15.6-inch 144Hz FullHD gaming display is fed by an Intel Core i7-8750H CPU, 16GB of RAM and either a Nvidia GTX 1060 or a GTX 1070 (Max-Q) GPU. Both these configurations come with a ridiculously fast (2000MB/s read/write) PCIe connected SSD, but this comes at a cost to overall space. While the premium rig offers a tight but adequate 512GB of total internal storage, the cheaper model offers just 256GB, which will hamstring the device for many. The CPU performance on this unit was a little less than we'd expected with a Cinebench CPU Multi-threaded score of 918, about 11% lower than the Dell G5 15 and 18% higher than the Asus TUF FX504 – which are both running the same CPU and 16GB of RAM. The Nvidia GTX 1070 (Max-Q) GPU is a step up from a lot of the offerings here, netting average frame rates that were 16.5% better than a Max-Q GTX 1060 on the Dell G5 15's *Total War: Warhammer 2* (1080p, Ultra) test. The GS65 Stealth isn't the best graphical performer, getting between 7% and 15% less than the average frame rates of the Razer Blade 15 (running identical components) across all the gaming titles we tested. Thermals were good and you get a 6 hour and 20 minute movie playback battery life to boot.

Verdict

If you can live without much storage, this gaming ultrabook is MSI's best dressed.

★★★★½

Windows 10 Home 64-Bit, 15.6-inch 144Hz IPS display @ 1920 x 1080 pixel resolution, Intel Core i7-8750H CPU, Nvidia Max-Q GTX 1060 or 1070 GPU, 16GB RAM, 256GB or 512GB NVMe PCIe SSD, 80Wh battery (6:20hrs movie playback), 35.8 x 24.8 x 1.8 cm, 1.88kg.

FROM $2,999, TESTED: $3,999 | WWW2.RAZER.COM/AU-EN/

RAZER Blade 15 (2018)

Still one of the most refined gaming laptops on the market.

Razer has a legacy of gaming laptops that look as sleek as any professional ultrabook that Apple can put out and this year's Blade 15 is no different. Wrapped in a powdery space black metal chassis, the Blade 15 squeezes a vibrant 15.6-inch IPS display into a 14-inch form factor. There's also a clear concern for craftsmanship and style with a nicely weighted keyboard that ditches the number pad for symmetrical speakers and a generous, powdery touchpad. The entry Blade 15 has a 60Hz display, Nvidia GTX 1060 GPU and a 256GB NVMe SSD, but this can be upgraded to variants with a 144Hz display and either a GTX 1070 GPU or a 512GB NVMe SSD, or both. These components are unified with 16GB of RAM and a CPU that's pretty common among high-end gaming laptops, the Intel Core i7-8750H CPU. This configuration managed to produce a score of 1,082 on Cinebench's Multi Threaded CPU benchmark – some 6% better than the Mid 2018 MacBook Pro (APC#460 p22) and has 4.8% on Dell's G5 15. In gaming tests this rig was near the top with fps averages of 45.8 on *Ghost Recon: Wildlands* on 1080p Ultra settings. The 80.2 Wh LiPo battery lines up with MSI's GS65 Stealth but falls short of the 94.2Wh batteries on Gigabyte's Aero 15 (2018). At just 1.7cm thick this laptop is the slimmest gaming laptop we have on record, but at 2.15kg it's 270g heavier than the GS65 Stealth. You're also looking at a $600 premium on the model we tested with the identically specced GS65 Stealth and Aero 15 (2018) costing just $3,399 to the Razer Blade 15's $3,999.

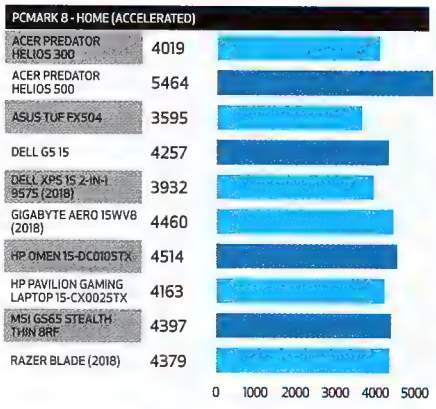
Verdict

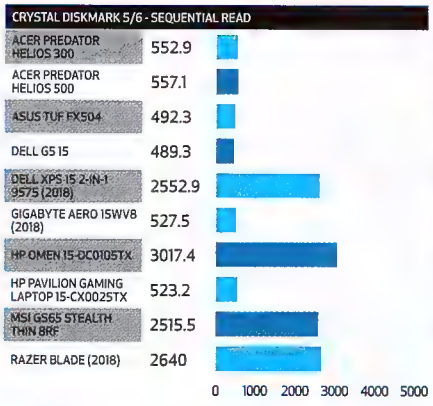
An extremely appealing gaming laptop that charges a big premium for its discrete design.

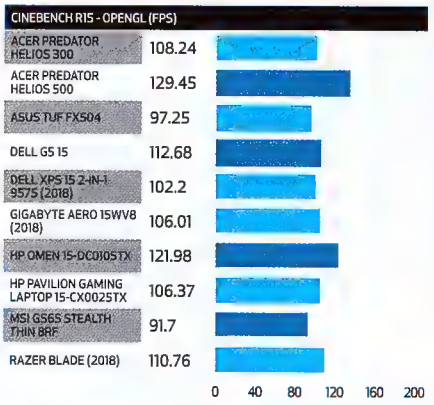
★★★★☆

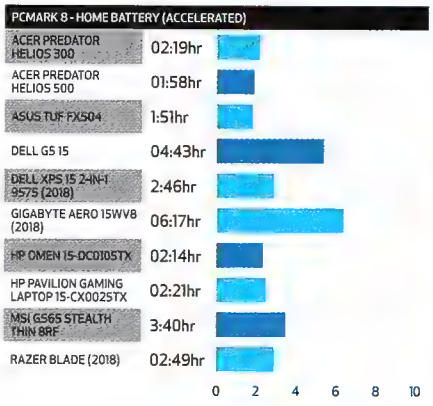
Windows 10 Home 64-bit; 15.6-inch 60Hz Touchscreen IPS display @ 3840 x 2160 pixel resolution OR 144Hz IPS display 1920 x 1080 pixel resolution; Nvidia GeForce GTX 1060 or GTX 1070 GPU; 16GB RAM; 256GB or 512GB Samsung NVMe SSD; 80.2Wh Li-Ion battery (2:49 PCMark 8 Home); 17.3 x 235 x 355mm; 2.15kg.

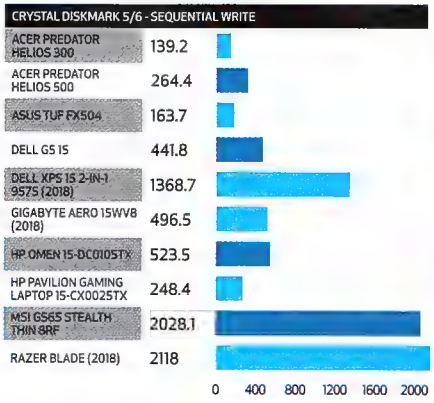
LABS BENCHMARK RESULTS

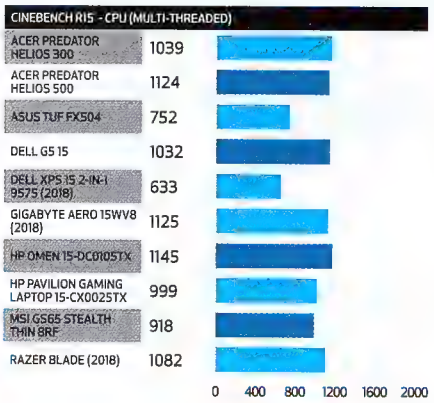

PCMARK 8 - HOME (ACCELERATED)
ACER PREDATOR HELIOS 300 4019
ACER PREDATOR HELIOS 500 5464
ASUS TUF FX504 3595
DELL G5 15 4257
DELL XPS 15 2-IN-1 9575 (2018) 3932
GIGABYTE AERO 15WV8 (2018) 4460
HP OMEN 15-DC0105TX 4514
HP PAVILION GAMING LAPTOP 15-CX0025TX 4163
MSI GS65 STEALTH THIN 8RF 4397
RAZER BLADE (2018) 4379
0 1000 2000 3000 4000 5000


CRYSTAL DISKMARK 5/6 - SEQUENTIAL READ
ACER PREDATOR HELIOS 300 552.9
ACER PREDATOR HELIOS 500 557.1
ASUS TUF FX504 492.3
DELL G5 15 489.3
DELL XPS 15 2-IN-1 9575 (2018) 2552.9
GIGABYTE AERO 15WV8 (2018) 527.5
HP OMEN 15-DC0105TX 3017.4
HP PAVILION GAMING LAPTOP 15-CX0025TX 523.2
MSI GS65 STEALTH THIN 8RF 2515.5
RAZER BLADE (2018) 2640
0 1000 2000 3000 4000 5000


CINEBENCH R15 - OPENGL (FPS)
ACER PREDATOR HELIOS 300 108.24
ACER PREDATOR HELIOS 500 129.45
ASUS TUF FX504 97.25
DELL G5 15 112.68
DELL XPS 15 2-IN-1 9575 (2018) 102.2
GIGABYTE AERO 15WV8 (2018) 106.01
HP OMEN 15-DC0105TX 121.98
HP PAVILION GAMING LAPTOP 15-CX0025TX 106.37
MSI GS65 STEALTH THIN 8RF 91.7
RAZER BLADE (2018) 110.76
0 40 80 120 160 200


PCMARK 8 - HOME BATTERY (ACCELERATED)
ACER PREDATOR HELIOS 300 02:19hr
ACER PREDATOR HELIOS 500 01:58hr
ASUS TUF FX504 1:51hr
DELL G5 15 04:43hr
DELL XPS 15 2-IN-1 9575 (2018) 2:46hr
GIGABYTE AERO 15WV8 (2018) 06:17hr
HP OMEN 15-DC0105TX 02:14hr
HP PAVILION GAMING LAPTOP 15-CX0025TX 02:21hr
MSI GS65 STEALTH THIN 8RF 3:40hr
RAZER BLADE (2018) 02:49hr
0 2 4 6 8 10


CRYSTAL DISKMARK 5/6 - SEQUENTIAL WRITE
ACER PREDATOR HELIOS 300 139.2
ACER PREDATOR HELIOS 500 264.4
ASUS TUF FX504 163.7
DELL G5 15 441.8
DELL XPS 15 2-IN-1 9575 (2018) 1368.7
GIGABYTE AERO 15WV8 (2018) 496.5
HP OMEN 15-DC0105TX 523.5
HP PAVILION GAMING LAPTOP 15-CX0025TX 248.4
MSI GS65 STEALTH THIN 8RF 2028.1
RAZER BLADE (2018) 2118
0 400 800 1200 1600 2000


CINEBENCH R15 - CPU (MULTI-THREADED)
ACER PREDATOR HELIOS 300 1039
ACER PREDATOR HELIOS 500 1124
ASUS TUF FX504 752
DELL G5 15 1032
DELL XPS 15 2-IN-1 9575 (2018) 633
GIGABYTE AERO 15WV8 (2018) 1125
HP OMEN 15-DC0105TX 1145
HP PAVILION GAMING LAPTOP 15-CX0025TX 999
MSI GS65 STEALTH THIN 8RF 918
RAZER BLADE (2018) 1082
0 400 800 1200 1600 2000

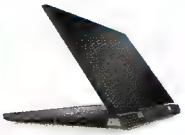
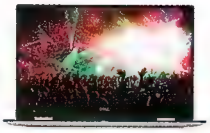
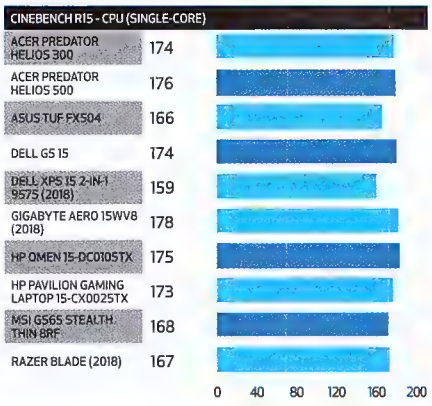
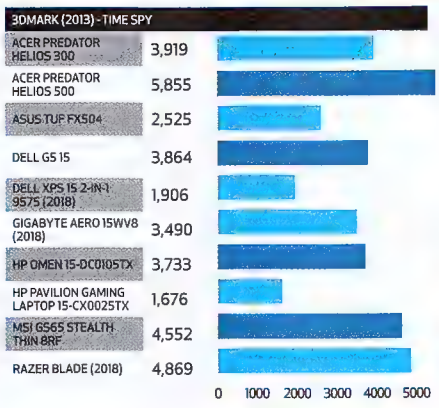



TABLE HEADLINE

	ACER PREDATOR HELIOS 300	ACER PREDATOR HELIOS 500	ASUS TUF FX504	DELL G5 15	DELL XPS 15 2-IN-1 9575 (2018)
STREET PRICE	FROM $1,999	FROM $2,694	FROM $1,499	FROM $1,799	FROM $2,899 (ON SALE)
SCORE	3.5	4	4/5	3.5	4.5/5
CPU	INTEL CORE I7-8750H	INTEL CORE I7-8750H	INTEL CORE I7-8750H	INTEL CORE I7-8750H	INTEL CORE I7-8705G
MEMORY	16GB	16GB	16GB	16GB	16GB
GPU	NVIDIA GEFORCE GTX 1060	NVIDIA GEFORCE GTX 1070	NVIDIA GEFORCE GTX 1050TI	NVIDIA GEFORCE GTX 1060 (MAX-Q)	RADEON RX VEGA M GL
STORAGE 1	128GB HITACHI SATA SSD	256GB HITACHI SATA SSD	256GB MICRON SATA SSD	256GB MICRON SATA SSD	1TB PC401 NVME SK HYNIX
STORAGE 2	NA	1TB WD HDD	1TB SEAGATE HYBRID HDD	1TB HDD	N/A
SCREEN SIZE	15.6 -INCH	17.3-INCH	15.6-INCH	15.6-INCH	15.6-INCH
SCREEN TYPE	60HZ IPS	144HZ IPS	120HZ TN OR 60HZ IPS	60HZ IPS	10 POINT TOUCHSCREEN
RESOLUTION	1920 X 1080 (16:9)	1920 X 1080 (16:9)	1920 X 1080	1920 X 1080 (16:9)	3840 X 2160 (16:9)
SCREEN FINISH	MATTE	GLOSS	GLOSS	MATTE	GLOSS
BATTERY CAPACITY	48.9WH	74WH LI ION	45 WH LI-ION	56WH	71WH LIP
DIMENSIONS (CM)	39 X 26.6 X 2.7	42.8 X 29.8 X 3.9	38.4 X 26.2 X 2.51	2.49 X 38.9 X 27.5	35.4 X 23.5 X 1.6
THICKNESS (CM)	2.7	3.9	2.5	2.5	1.6
WEIGHT	2.7KG	3.795	2.3KG	2.83KG	2KG


CINEBENCH R15 - CPU (SINGLE-CORE)
ACER PREDATOR HELIOS 300 174
ACER PREDATOR HELIOS 500 176
ASUS TUF FX504 166
DELL G5 15 174
DELL XPS 15 2-IN-1 9575 (2018) 159
GIGABYTE AERO 15WV8 (2018) 178
HP OMEN 15-DC0105TX 175
HP PAVILION GAMING LAPTOP 15-CX0025TX 173
MSI GS65 STEALTH THIN 8RF 168
RAZER BLADE (2018) 167
0 40 80 120 160 200


3DMARK (2013) - TIME SPY
ACER PREDATOR HELIOS 300 3,919
ACER PREDATOR HELIOS 500 5,855
ASUS TUF FX504 2,525
DELL G5 15 3,864
DELL XPS 15 2-IN-1 9575 (2018) 1,906
GIGABYTE AERO 15WV8 (2018) 3,490
HP OMEN 15-DC0105TX 3,733
HP PAVILION GAMING LAPTOP 15-CX0025TX 1,676
MSI GS65 STEALTH THIN 8RF 4,552
RAZER BLADE (2018) 4,869
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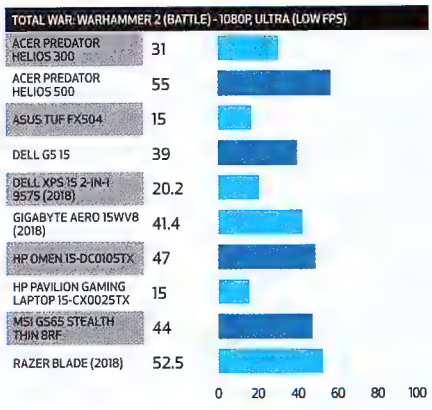
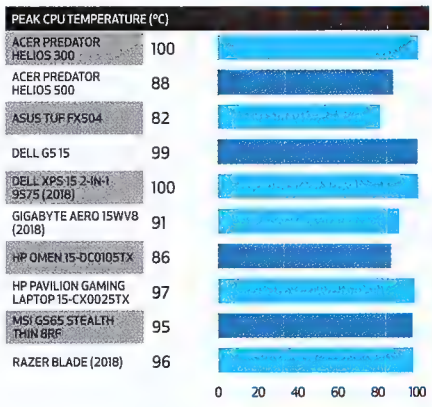
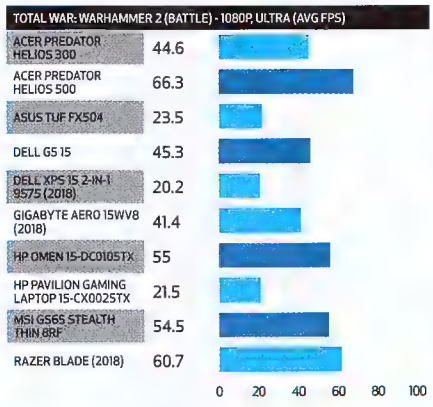
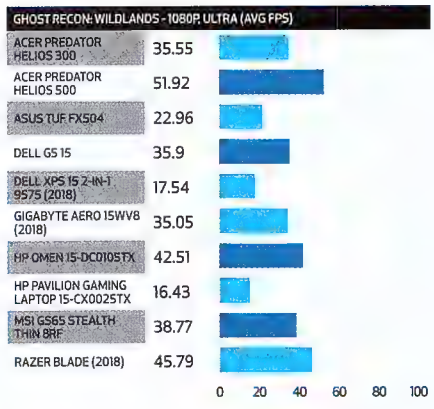

TOTAL WAR: WARHAMMER 2 (BATTLE) - 1080P, ULTRA (LOW FPS)
ACER PREDATOR HELIOS 300 31
ACER PREDATOR HELIOS 500 55
ASUS TUF FX504 15
DELL G5 15 39
DELL XPS 15 2-IN-1 9575 (2018) 20.2
GIGABYTE AERO 15WV8 (2018) 41.4
HP OMEN 15-DC0105TX 47
HP PAVILION GAMING LAPTOP 15-CX0025TX 15
MSI GS65 STEALTH THIN 8RF 44
RAZER BLADE (2018) 52.5
0 20 40 60 80 100


PEAK CPU TEMPERATURE (°C)
ACER PREDATOR HELIOS 300 100
ACER PREDATOR HELIOS 500 88
ASUS TUF FX504 82
DELL G5 15 99
DELL XPS 15 2-IN-1 9575 (2018) 100
GIGABYTE AERO 15WV8 (2018) 91
HP OMEN 15-DC0105TX 86
HP PAVILION GAMING LAPTOP 15-CX0025TX 97
MSI GS65 STEALTH THIN 8RF 95
RAZER BLADE (2018) 96
0 20 40 60 80 100

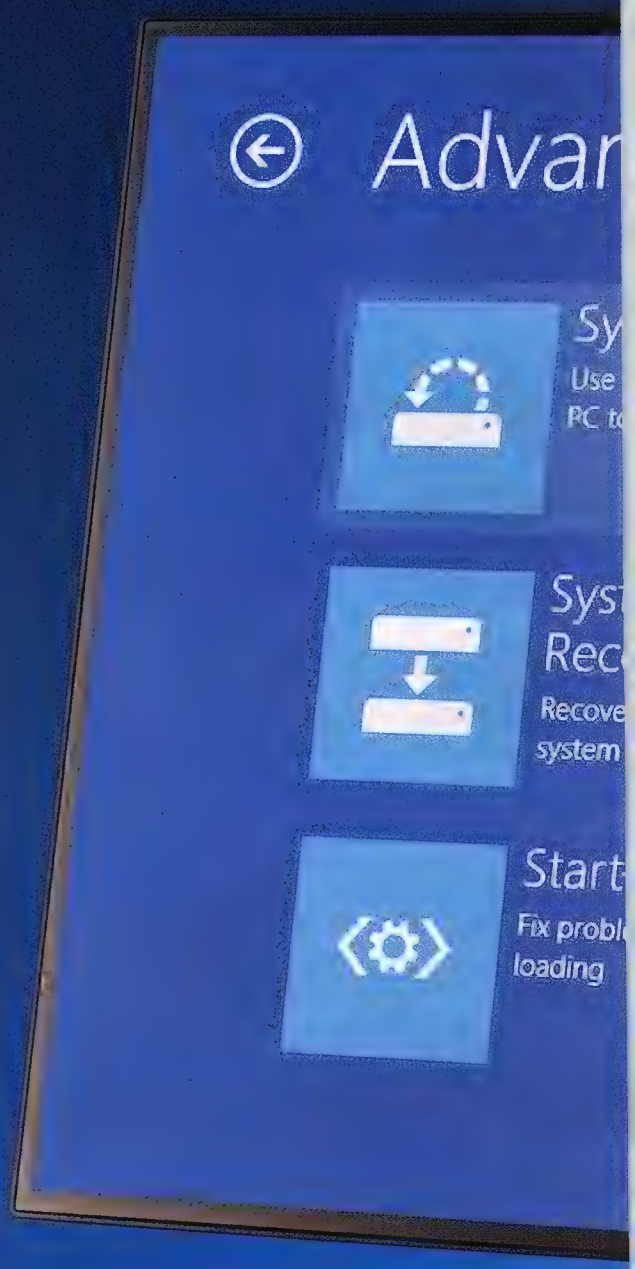

TOTAL WAR: WARHAMMER 2 (BATTLE) - 1080P, ULTRA (AVG FPS)
ACER PREDATOR HELIOS 300 44.6
ACER PREDATOR HELIOS 500 66.3
ASUS TUF FX504 23.5
DELL G5 15 45.3
DELL XPS 15 2-IN-1 9575 (2018) 20.2
GIGABYTE AERO 15WV8 (2018) 41.4
HP OMEN 15-DC0105TX 55
HP PAVILION GAMING LAPTOP 15-CX0025TX 21.5
MSI GS65 STEALTH THIN 8RF 54.5
RAZER BLADE (2018) 60.7
0 20 40 60 80 100


GHOST RECON: WILDLANDS - 1080P, ULTRA (AVG FPS)
ACER PREDATOR HELIOS 300 35.55
ACER PREDATOR HELIOS 500 51.92
ASUS TUF FX504 22.96
DELL G5 15 35.9
DELL XPS 15 2-IN-1 9575 (2018) 17.54
GIGABYTE AERO 15WV8 (2018) 35.05
HP OMEN 15-DC0105TX 42.51
HP PAVILION GAMING LAPTOP 15-CX0025TX 16.43
MSI GS65 STEALTH THIN 8RF 38.77
RAZER BLADE (2018) 45.79
0 20 40 60 80 100

	GIGABYTE AERO 15WV8 (2018)	HP OMEN 15-DC0105TX	HP PAVILION GAMING LAPTOP 15-CX0025TX	MSI GS65 STEALTH THIN 8RF	RAZER BLADE (2018)
STREET PRICE	FROM $2,699	FROM $2,199	FROM $1,749	FROM $2,799	FROM $2,999
SCORE	4.5	4/5	4/5	4.5	4/5
CPU	INTEL CORE I7-8750H	INTEL CORE I7-8750H	INTEL CORE I7-8750H	INTEL CORE I7-8750H	INTEL CORE I7-8750H
MEMORY	16GB	32GB	16GB	16GB	16GB
GPU	NVIDIA GEFORCE GXT 1060	NVIDIA GEFORCE GTX 1070	NVIDIA GEFORCE GTX 1050	NVIDIA GEFORCE GTX 1070 (MAXQ)	NVIDIA GEFORCE GTX 1070 (MAX Q)
STORAGE 1	512GB CRUCIAL M.2 SATA3 SSD (CT525MX300SSD4)	512GB TOSHIBA NVME SSD	128GB SANDISK SATA SSD	512GB SAMSUNG NVME PCIE	512GB SAMSUNG NVME PCIE SSD
STORAGE 2	N/A	1TB HITACHI HDD	1TB SEAGATE HDD	NA	NA
SCREEN SIZE	15.6-INCH	15.6-INCH	115.6-INCH	15.6-INCH	15.6-INCH
SCREEN TYPE	144HZ IPS PANTONE COLOUR CALIBRATION	60HZ OR 144HZ G-SYNC IPS	60HZ IPS	144HZ IPS	144HZ IPS
RESOLUTION	1920 X 1080 (16:9)	3840 X 2160 (16:9)	1920 X 1080 (16:9)	1920 X 1080 (16:9)	1920 X 1080 (16:9)
SCREEN FINISH	GLOSS	MATTE	GLOSS	GLOSS	MATTE
BATTERY CAPACITY	94.2WH	66WH	52.55WH	80WH	80.2WH
DIMENSIONS (CM)	35.64 X 25.0 X 1.89	36 X 26.3 X 2.6	36.5 X 25.65 X 2.54	35.77 X 24.77 X 1.79	1.73 X 23.5 X 35.5
THICKNESS (CM)	1.9	2.6	2.54	1.8	1.7
WEIGHT	2.04KG	2.48KG	2.36KG	1.88KG	2.15KG

THE WINDOWS 10 DIY SUPPORT MANUAL

If you've got a problem and nobody else can solve it, try looking a little closer to home. By Ian Evenden



When it comes to tech, a little knowledge goes a long way. Windows 10, especially as it becomes more mature, is growing in stability, and it's a long way ahead of its predecessors, but – and it's a big but – it is still beset by little niggles and gripes that can make it difficult to use. However, you're the master of your own domain, and you can be the master of your own PC. Those problems can be banished by a little knowledge, either of the right thing to do or the right place to look.

So, we're bringing you a collection of the most common Windows 10 problems and the best ways to solve them. We've broken them up into categories to help you find your way around, so the next time you run into an issue, check this guide – chances are the solution will be here, but if you're still stumped, we'll lead you to the right places to find the answer.

Struggling to understand how Windows Update works? Frustrated because it's not working the way it should? Then you've come to the right place. In this feature, we're also going to take you on a complete tour of Windows Update in Windows 7, 8.1, and 10. We take a close look at what Windows Update does and – critically – how it works. You'll discover the different types of update it provides, and how it packages them up and delivers them to your PC. If you're running Windows 10, you may be in for a shock, because we reveal how to take back control of how updates are delivered from Microsoft.

Speaking of taking back control, we'll also reveal how to manually stop Windows Update from forcing updates down your throat if you're running Windows 10 Home Edition, and take an in-depth look at how to update and control the process if you're running Windows 10 Pro, or an earlier version of Windows.

Last, but by no means least, we'll take a look at troubleshooting those pesky Windows Update problems you're almost certain to run into. You'll find out how to fix most problems using a combination of Windows and third-party tools, track down solutions to stubborn updates refusing to install, and even take steps to get your PC working again should an update render your PC unbootable.

Enough talk, let's start taking control....

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Use the Command Prompt for advanced troubleshooting
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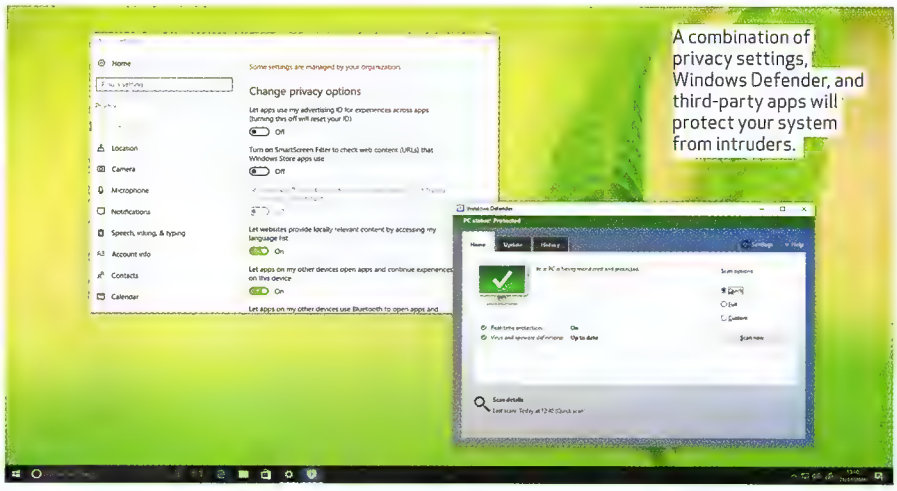
1 THE PERFECT WINDOWS PC

If you're planning to move to Windows 10, installing the OS might be the first area where you run into problems. Installing a new operating system requires a certain amount of free space on your drive, so that it can be downloaded and certain elements can be run successfully.

For Windows 10, the minimum space requirement is 16GB, which should be kept free on the main system drive the computer uses. This is actually the same as previous versions of Windows, so if you've upgraded before, you can most likely do it again. To check how much space you have left, go to "My Computer" (or "This PC," depending on the version of Windows you're running), where any drives you have are listed. You can see the remaining space indicated underneath each drive, or you can right-click and select "Properties" for a clearer overview (the system drive is usually C:). Just as with space requirements, your PC also has to be capable of running Windows 10. This means it must reach certain minimum system requirements. Thankfully, the requirements for running Windows 10 are relatively low: a processor of 1GHz or faster; 1GB (32-bit) or 2GB (64-bit) of RAM; 16GB of free drive space; a Microsoft DirectX 9 graphics device; a Microsoft account; and Internet access. To find out your PC's spec, go to "Control Panel" and select "System & Security," then "System."



A combination of privacy settings, Windows Defender, and third-party apps will protect your system from intruders.

2 ACTIVATE

Some users have reported issues with activating their copies of Windows 10, which could have been down to a number of different reasons. In some cases, the easiest way to get around the problem is to ensure you have purchased a legitimate copy of Windows 10.

Unlike previous versions of Windows, this latest one is almost exclusively available online, which means that official Microsoft websites are the best bet for your purchase. The company was once giving the OS away for free, but that promotion has now ended.

Microsoft has a helpful website that provides a downloadable copy in either 32-bit or 64-bit versions. If you find that you're unable to activate Windows 10, Microsoft has introduced an activation troubleshooter; head to "Settings," then click "Update & Security," go to "Activation," and select "Troubleshoot" (you won't see this option if Windows 10 has already been activated).

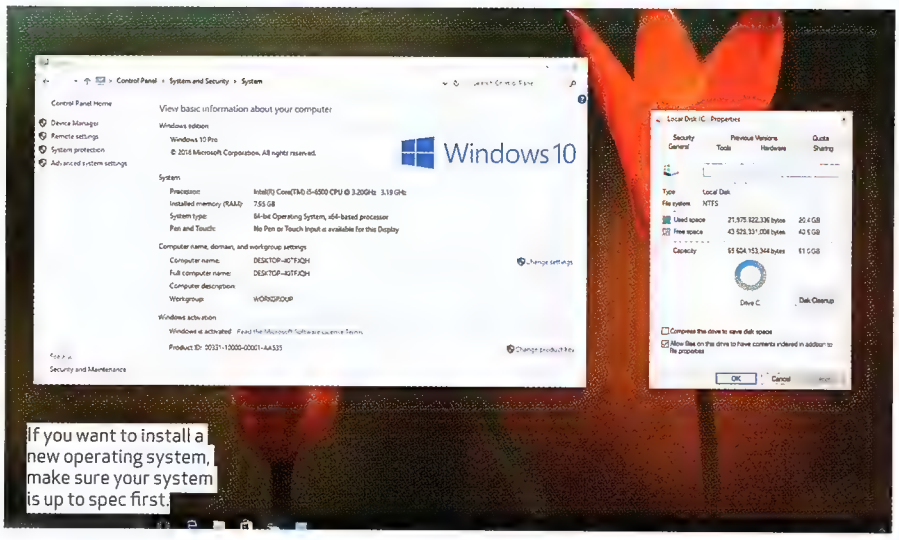
3 UPDATES

Windows 10 is, in many ways, a truly Internet-based OS. Mostly this is a bonus, but there are times when it isn't — and Microsoft's attitude toward downloading and installing operating system updates is one such time.

The most annoying part of automatic updates is the restarting, which can seemingly come at random (and inconvenient times). The simplest way to counteract this is to head to Windows Update (in "Settings > Update & Security"), click "Advanced Options," and then "Notify to Schedule Restart," which means the OS will request a reboot rather than trample all over the work you're not quite done with yet.

Each version of a new operating system also comes with its own set of backward compatibility issues, and Windows 10 is no exception. The transition from Windows 8.1 to 10 was far less jarring than the move from Windows 7 to 8, but there are still certain applications that can become broken and, in some cases, cease to work at all.

One such application is Chrome, which some users have had to fully delete and reinstall. If a program isn't working with Windows 10, try looking in the Microsoft Store or on the official website for the software to find an update. If that doesn't work, delete and reinstall it. Over time, more and more developers have updated their programs for Windows 10 compatibility, so this is now less of a problem than it was.



If you want to install a new operating system, make sure your system is up to spec first.

4 BROWSERS

The web browser has become the heart of the modern PC. Microsoft ships Windows 10 with Edge, the successor to its Internet Explorer browser (although IE is still present in the operating system). For many people, however, using Chrome or Firefox is the norm, no matter what Microsoft wants.

To install Chrome or Firefox, open Edge, search for either browser, and find a Windows 10 version. Download it, install it, and make sure it's set as the default browser option, so Edge doesn't keep reappearing. To do this, head to "Settings > System," and click "Default Apps"—click under "Web Browser," and then select your preferred default browser.

If you do want to use Edge, you'll find it's actually a decent browser, but it does come with some annoying features. Because it's a Universal Windows App, Edge runs on smartphones, tablets, PCs, and almost

any other device. This means that it sometimes has a problem with being too much like a phone app rather than a PC program.

One of the ways this manifests itself is by sometimes refusing to play media when minimised, just as a phone app wouldn't. There's a fix for this, but it's tucked away in a rather obscure location. Head to "Settings > Privacy > Background apps," and enable Microsoft Edge (switch it to "On") in the list on the right, to enable the browser to keep itself going in the background. There's another issue with Edge, and it's often one of personal taste: many people just don't like the Bing search engine, most likely because they've always used Google. That's fine, and we're sure Microsoft understands.

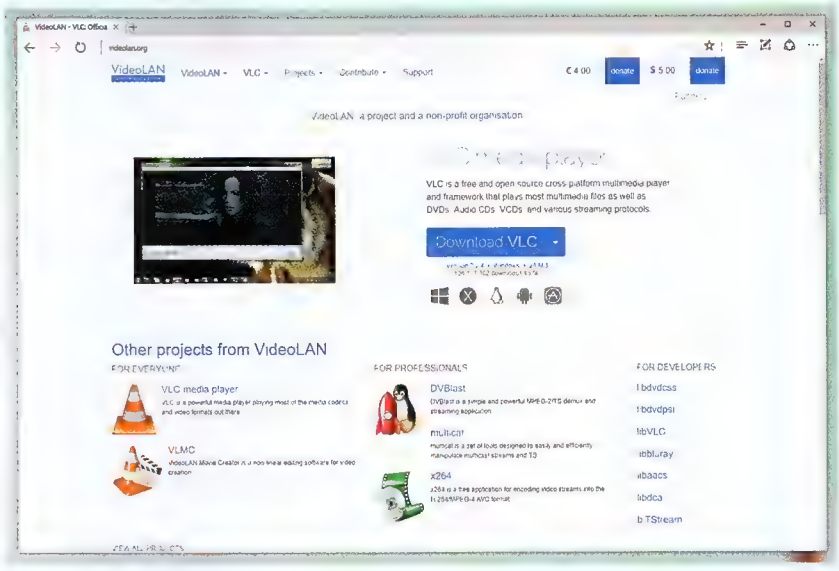
Changing Edge's search engine over to Google is relatively simple. Navigate in Edge to **www.google.com** (or Yahoo, or whatever your preference), and click the ellipsis (...) in the top-right. A drop-down menu appears: Select "Settings," then navigate down to click "View Advanced Settings." From here, scroll down to "Search in the address bar with..." and select "Add New." Some users have reported that "Add New" often has no results in it, suggesting that no new search engine can be added. This isn't true. To get past this, close and then reopen Edge, and (hopefully) some results will appear. One slight issue: You can't ask Cortana to search with Google; it always uses Bing, which can be something of an irritation.

5 PRIVACY

Data security is incredibly important as hackers become more sophisticated, and the number of complex cyber-attacks is on the up. An unprotected PC is basically an invitation to be interfered with, and you might not know you're being exploited – the days of openly malicious viruses are mostly behind us.

Windows 10 comes with a decent set of built-in protection measures, but you can never be too careful. One such feature that should be disabled by privacy-minded individuals is Wi-Fi Sense, which automatically shares the Wi-Fi password across Win 10 devices on the same account.

Microsoft updated Wi-Fi Sense to share less data, but switching it off is the ideal way to prevent anything you don't want to happen. Go to the Start menu, select "Settings," click "Network & Internet," then "Wi-Fi," and head to "Manage Wi-Fi Settings"—turn off all the options in here. Also in "Settings," you can get an overview of everything else happening on Win 10 in terms of privacy under the "Privacy" section. Here, you're presented with a bunch of toggles that adjust some privacy



Media maladies

Annoyingly, Windows 10 ships without DVD-playing software. However, Microsoft offers an app from the Microsoft Store called Windows DVD Player, but it costs $22.45. The best bet if you want to watch DVDs is VLC Media Player, which is free to download, and fully supports Windows 10. VLC Media Player also supports a host of other file formats – even the weird ones – making it a very useful tool.

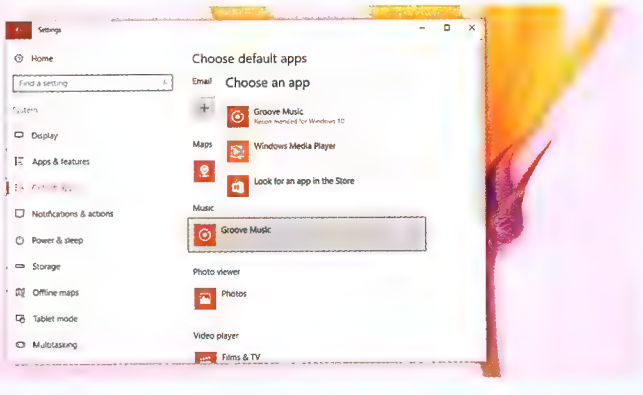
Many of us have moved on from DVDs to the wild world of media streaming. Netflix and Amazon Prime both work on Win 10's default browser, Edge, but may need an update to Silverlight, an application framework that Microsoft created and maintains.

If you've upgraded from a Win 7 PC, you could well suffer from this issue, as the older version of Silverlight may have traveled across when you migrated. So, if you're encountering streaming gremlins, go to the Microsoft website, where you can reinstall Silverlight – follow the instructions as detailed on the web page.

Then there's music. Although Microsoft still bundles Groove Music with Win 10, the service has been deprecated, with Microsoft recommending Spotify instead. However, there are plenty of alternatives, from Google Music to Deezer and Tidal, as well as Apple Music, with a standalone version of Apple's iTunes for Win 10 now available from the Microsoft Store.

Browser-based streaming services – such as Google Music – are also supported, of course, but bear in mind that they may not work well in Edge, as Win 10's browser doesn't stream multimedia when minimised. At any rate, to set the default music service (the one songs automatically play with), head to "Start > Settings > System," and select the "Default Apps" tab. You'll see a "Music Player" section, which presents options based on the players you have installed. Select the one you want, and click "OK."

If you just want to play your existing music collection, then try MusicBee (**https://getmusicbee.com**). It's easy to use, powerful, and free.



Speed-ups

The easiest way to fix a PC booting sluggishly is to reduce the number of apps that launch on startup, as having too many programs firing up when the computer starts makes the whole process much slower, especially when it comes to older hardware.

To trim those apps, press Ctrl-Shift-Esc to bring up Task Manager, then click the link that says "More Details." From here, select the "Startup" tab. Look through the list of enabled apps, and find any that you don't need – you can turn an app off by right-clicking it, and selecting "Disable." Disabled apps don't automatically load on boot up. Be careful not to turn Microsoft services off, though, or important apps, such as antivirus. If you're unsure whether it's wise to disable a certain app, Google it to find out.

Let's think beyond physical speed now, and more toward efficiency. Do you feel as though it takes ages to get anything done in Windows 10? The "Quick Access" menu is located in File Explorer, and it can save a ton of time. To add files, folders, or apps to the sidebar, right-click their icon, and select "Pin to Quick Access." This means they show up and can be easily accessed, which is useful for recently visited folders. You can also set File Explorer to load the "Quick Access" menu by default when you bring it up, rather than "This PC." To do so, with File Explorer open, click the "View" tab in the top menu (next to "Share"), then click "Options," and select "Change folder and search options." Look where it says "Open File Explorer to," and use the drop-down menu to select "Quick Access."

options to help keep everything under control.

Windows 10 also ships with a variety of security features that are worth looking at. One such feature to be aware of is Windows Defender, which is designed to detect and remove malware from PCs – it's under "Settings › Update & Security." Make sure you turn it on if you don't have a third-party antivirus solution running. Equally, don't rely on Defender; it's one of the least effective antivirus tools there is, and you should definitely apply some third-party protection, even if it's something free, such as Avira (**www.avira.com**).

Windows Firewall is the other half of Microsoft's basic efforts to keep your PC safe. It's easy to turn on, but configuring the firewall is a slightly more involved matter. To switch on the firewall, or rather, to make sure it's switched on as it should be by default, type "firewall" into the search/Cortana box (next to the Start menu), and click "Windows Firewall." From here, there's an option to turn it on (or off), and you can also adjust its relative "strength."

Windows Firewall can be set as incredibly strong via "Advanced Settings"—blocking all suspect apps without asking – or slightly weaker, so there's a slightly greater risk that your PC will be hit by an infection, but the firewall won't interfere as much.

6 INPUT ISSUES

If you've bought a Windows 10 machine with a touchscreen, you are, by and large, getting the best experience with the OS. Ever since Win 8, Microsoft has been optimising its operating system for the finger – and sometimes pen – with large tiles, easy-to-scroll menus, and so on. It can still be a little disjointed, but the way to remedy this is simple: Go to "Start › Settings › System › Tablet Mode." Then turn Tablet Mode on—this optimises Win 10 for fingers rather than pointers, making it far easier to use.

Having a touchpad-enabled laptop is also good for Windows 10, but some users have reported that the upgrade from Windows 7 (and sometimes Windows 8) breaks it.

One of the ways to solve this is by first checking to see if your keyboard has a key that turns the touchpad off. You usually have to use the Fn key on your laptop with one of the F-keys; look for a symbol that looks like a rectangle with a cross through it.

If your laptop doesn't have such a function – or the right setting is toggled and you're still having issues – head to "Devices › Mouse & Touchpad › Additional mouse options." A new window appears. From here, select the "Device Settings" tab, then "Devices," and make sure the touchpad is enabled. If none of these options work, press Win-X, select "Device Manager," then "Mice and other pointing devices," and update the driver. This should fix things.

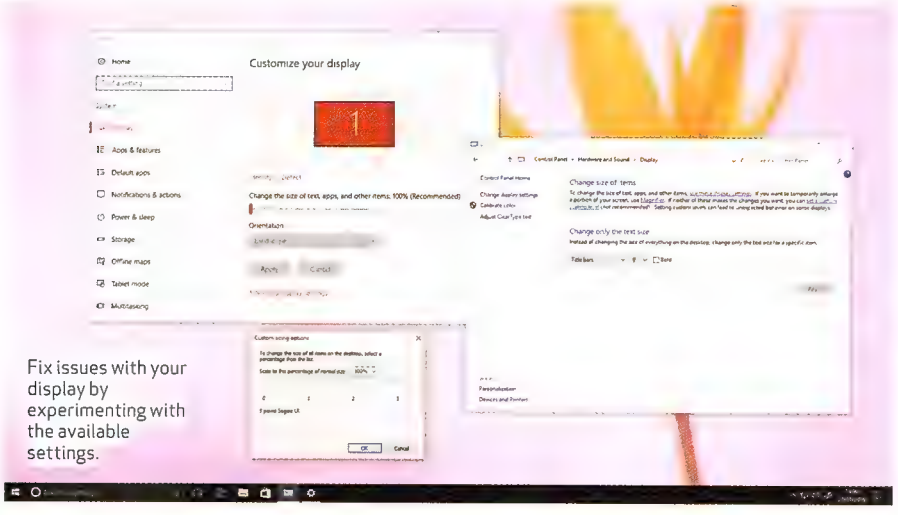
7 HARDWARE

We can't all keep up with the latest changes in tech—and neither should we have to—but this can, naturally, cause issues. Let's start with printer compatibility. If you're jumping from Windows 7 (or earlier) to Windows 10, it's definitely worth updating all available printer drivers, which should help prevent them not working post-upgrade. Doing this is simple. Just search Google (or Bing, depending on your preference) for the name of your printer, and download the latest Windows 10 compatible drivers. Follow the manufacturer's instructions to install them, and you're good to go.

Now on to screens. Users have reported issues with high-resolution displays and Windows 10, including experiencing blurriness in applications that had been rendering fine on previous versions of the OS, such as Windows 8.1.

The easiest way to solve the issue of blurriness is by going to "Control Panel › Display," and fiddling around with the settings here. There is no single setting that will fix all issues, so experiment and see what works (and what doesn't).

To fix blurriness in specific applications, right-click the app's icon, and select "Properties." Under the "Compatibility" tab, there is an option to "Disable display scaling on high DPI settings." Check this and – hopefully –



Fix issues with your display by experimenting with the available settings.

the problems will disappear.

You may also find that your screen is flickering – this isn't always a hardware issue, as some users have found it to occur when upgrading to Windows 10.

The easiest way to fix this is to update all relevant drivers for monitors, as well as Norton Antivirus, iCloud, and IDT Audio, which are all suspected to be potential causes of these problems. It may even help to uninstall and then reinstall them.

Windows 10 does automatically update drivers, so there is also a chance it's forcing an incompatible version of a driver on to the PC without realizing.

If you found that an upgrade to Win 10 broke the connection of a Bluetooth device (or devices) that was previously paired up just fine with your machine, there is an easy fix for this. According to Microsoft, all you have to do is head to Device Manager (just type "device manager" into the search/Cortana box next to the Start menu), select the Bluetooth driver, and update it to the latest version, which will be compatible with Windows 10. The operating system should be able to automatically search, and then update, the driver. If that fails to work, unpairing (or "forgetting") the device before re-pairing it should fix the issue.

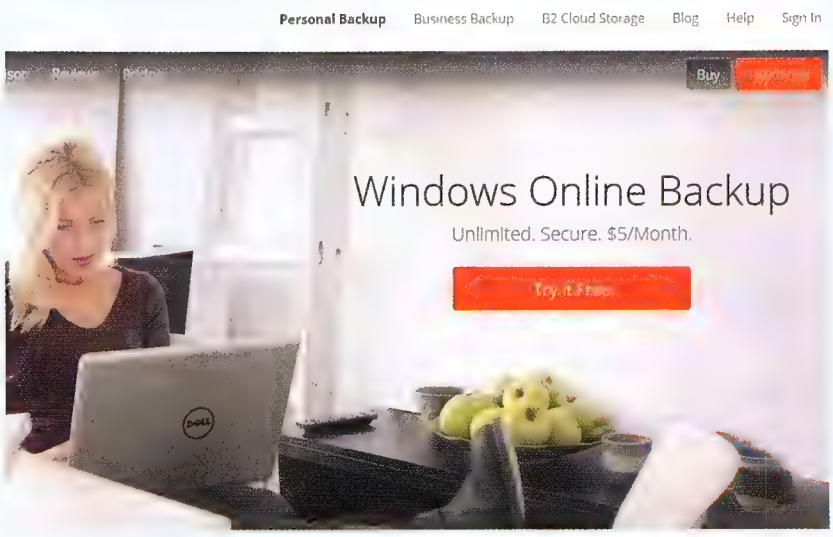
8 MOBILE COMPUTING

Battery life is important to anyone who regularly uses a laptop, tablet, or smartphone, and, of course, Windows 10 can be used on all three of those devices. Microsoft recognizes this – as shown by the marketing of its Edge browser as being battery-friendly – and has built several tools into Windows 10 to help cut down on excessive battery drain. All apps that run in the background can be toggled off, for example, which stops them from sucking up precious juice.

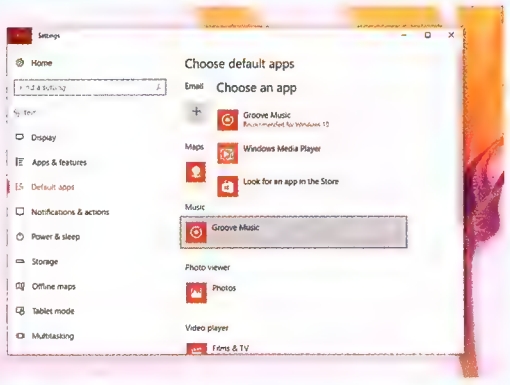
Windows 10 also includes a dedicated set of power options, which you can find via "Settings > System > Power & Sleep." From here, display sleep times can be set, and under "Additional Power Settings," you can select a power plan that means a lighter load for your battery.

If just fiddling with the settings isn't enough, Windows 10 can also generate a battery report. To do this, head to the Command Prompt Admin (which you get from right-clicking the Start menu), and type "powercfg /batteryreport /output "C:\battery_report.html"." This saves a file to any chosen folder—for example, C:\ in this case, the root of your system drive—which gives you a hugely detailed look at battery quality, cycles, how much charge is left, and much more. The report is a little dense, so be warned.

Location-based apps are fairly

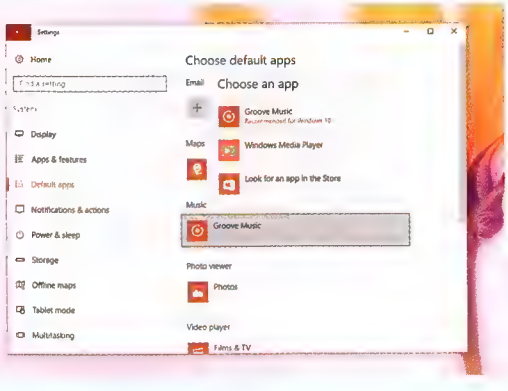


File safety



Losing files after disaster hits because you didn't back them up is hugely frustrating, but it can be easily avoided. To create a backup, buy an external storage drive (larger in size than the data you want to store on it). You can copy your files across to this disk manually, or you can set up File History in Windows. To do the latter, ensure the drive is connected to your PC, left-click the "Start" menu, then click "Settings." Click "Update & Security," and navigate to "Backup." See the "Add a Drive" button next to the "+" sign? Click this. Windows scans for available drives, and you should select the one you want to use from the list it brings up. The OS now gets to work; an "On" toggle button shows that the feature is active and automatically backing up your files (and will continue to do so as long as the drive is connected).

If a physical drive doesn't suit you (maybe you're worried about a fire, for instance), there are plenty of online backup options. Backblaze (**www.backblaze.com**) has received some very good reviews, and comes with various tiers suitable for single PCs right through to businesses. Alternatively, you could simply use a cloud storage locker, such as Dropbox or Microsoft's OneDrive, which is tied in directly with Windows 10.

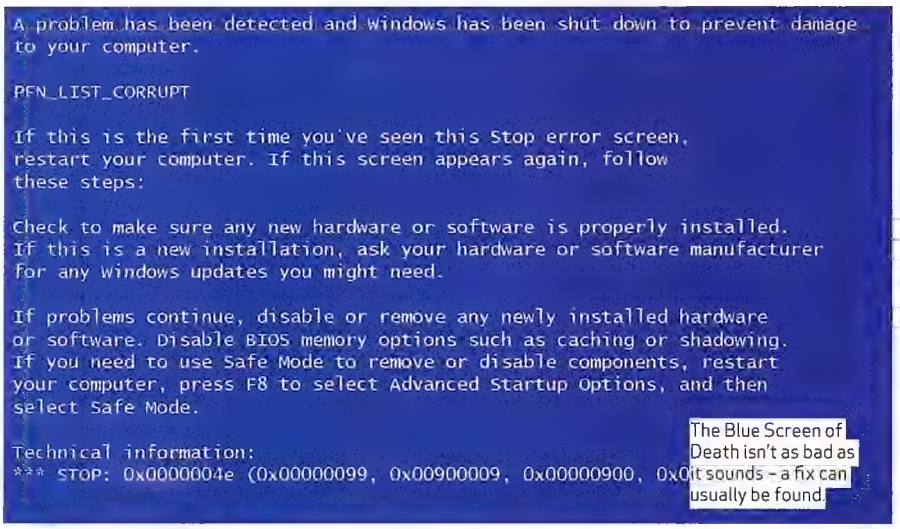


Whichever online option you choose, do be warned that sending all your files over an Internet connection could be a slow process—although that obviously depends on the quantity of files you have and the speed of your broadband. Also, be careful if you have data allowances on your broadband plan. It can be a good idea to have both a local backup on an external storage drive and a further online backup, even if the latter only holds critical files, not everything.

prominent in Windows 10, which makes it a good idea to let your PC know where you are. Cortana, for example, can give far more information if it can pinpoint where in the world it's being used.

To update your location settings, head to the Start menu, click "Settings > Time & Language," then click "Region & Language," and make sure the correct country is selected. To turn on Location services, go to "Settings > Privacy > Location," and flick the "Location" switch to "On."

If you're on a tablet that has 4G, or if you're using a mobile hotspot, or surfing the web via a 4G-enabled laptop, the operating system may have a nasty surprise for you. Users have been reporting that the default configuration of Windows 10 sucks up data like there's no tomorrow, potentially going over your data allowance, and leaving you with a hefty bill. Fortunately, there's an option that addresses the problem. Go to "Settings > Network & Internet > Wi-Fi." Click "Advanced Options," then "Set as metered connection" to stop Windows 10 collecting so much data in the background.


A problem has been detected and Windows has been shut down to prevent damage to your computer.
PFN_LIST_CORRUPT
If this is the first time you've seen this Stop error screen, restart your computer. If this screen appears again, follow these steps:
Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any Windows updates you might need.
If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup Options, and then select Safe Mode.
Technical information:
*** STOP: 0x0000004e (0x00000099, 0x00900009, 0x00000900, 0x0
The Blue Screen of Death isn't as bad as it sounds – a fix can usually be found.

"If you haven't logged in, or Win 10 hasn't booted, your immediate diagnostic path should be to check your Internet connection, then boot your PC in a different way."

9 MAJOR CRASHES

While Windows 10 is far more stable than many OSes that came before it, it's still prone to the odd bout of madness, so it pays to be prepared. A black screen on Windows 10 can mean several things, depending on whether you've logged in to the OS or not.

If you haven't logged in, or Win 10 hasn't booted, your immediate diagnostic path should be to check your Internet connection, then boot your PC in a different way. If you logged in, then the screen went black, unplug all external devices and, failing that, boot via Safe mode. It's just what you'd expect—a safe way of booting up a PC and running the system with no startup apps and only essential drivers, which should hopefully enable the computer to boot successfully (when it won't otherwise, due to some issue or other). With Windows 10, to access Safe mode, hold down Shift while booting up (or select "Restart" from the desktop while holding down Shift), then follow the menus on screen.

The Blue Screen of Death, also known as a BSOD or stop error, may sound bad, but it's certainly fixable in the majority of cases. When the problem manifests, it halts your PC completely, stopping it working, and showing a blue screen, usually with some kind of message about restarting or a critical error. You then need to reboot.

To fix this, you can explore several options. First, check how much available space you have left on your system drive, and if it's low, make some room by deleting bigger files or programs you don't need. Also, ensure all the latest updates are applied to the software on your machine, because having outdated apps can cause issues. While you're at it, update the hardware drivers of any peripherals, as the problem could be caused by Win 10 clashing with something. Head to "Device Manager," which you can reach by searching for it in the Start menu. Here, you can ensure that peripherals such as your monitor, webcam, printer, or scanner have the latest drivers, simply by right-clicking the device in question. Select "Update Driver Software," then click "Search automatically for updated driver software."

10 GLITCHES

It's not uncommon for certain software, particularly older apps, to encounter glitches or even fail to run completely with Windows 10. There's one potential way to get around show-stopping bugs, though: right-click the icon for the app, select "Properties," then click the "Compatibility" tab. From here, click the checkbox next to "Run this program in compatibility mode for," and in the drop-down menu underneath that, choose the version of Windows that the program previously ran fine on. Over time, many developers update their apps to remove bugs, so the software in question may eventually work perfectly well with Windows 10. An easy way to help this process is by reporting any bugs you come across – this can usually be done via the developer's website.

Alternatively, your machine may be in the grips of slowdown – perhaps your hard disk is whirring away like crazy? If so, there's a good chance that one of the programs you're currently running has developed some kind of issue, and is sapping all of your system resources. Luckily, there's a very simple way to find out whether an app has gone haywire and is bogging down your computer: You need to head over to Task Manager (press Ctrl-Shift-Esc together), and click "More Details"—you'll then see a list of processes, which is all the different apps and services that are running on your machine. Scan down the list, and look for any apps that are hogging CPU, memory, or disk usage – or perhaps all of the above.

Once you've discovered the culprit, select it. There's an option in the bottom-right corner to "End Task." However, be careful that you aren't ending important system-critical tasks – usually ones with confusing names that don't mean anything to you – because this could cause your computer to crash.

If in doubt, Google or Bing is your friend here – open your web browser, search for the app/service you need information on, and you'll almost certainly find an answer about exactly what it does.

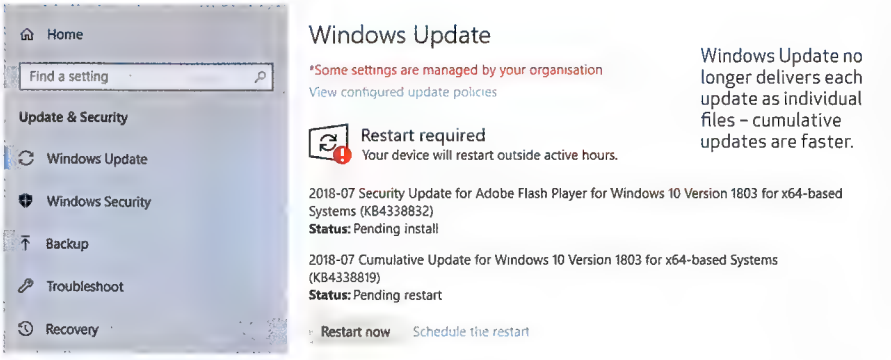
How Windows Update works

Let's start things off by explaining exactly what Windows Update does – and how it works.

Windows Update is designed to keep your copy of Windows up to date through the delivery of special files that "patch" it. The most obvious updates are security hotfixes, which patch vulnerabilities and security holes that could be exploited by malware, as well as bug fixes to resolve specific issues.

Windows Update also delivers bigger updates—what once were Service Packs, then point releases (Windows 8.1), have now evolved into feature updates, delivered bi-annually to add new features, and change the way existing features work. The latest feature update is the April 2018 Update (version 1803), set to be superceded by the October 2018 update.

There are also "optional" updates, which include other Microsoft tools, such as the .NET Framework, as well as signed hardware drivers, which have been tested and verified to work well with Windows. Some updates are "recommended," and so sit alongside important updates by default. All optional and recommended updates can be clearly found in the Windows Update tool in Win 7 and 8.1, but they're hidden from view in Win 10. We'll show you how to find, review, and install optional updates easily.



Windows Update no longer delivers each update as individual files – cumulative updates are faster.

Windows Update can also be extended to include updates for other Microsoft products, such as Office, or software for controlling Microsoft keyboards and mice.

These days, updates are packaged up and delivered to reduce their size and number, based on what's installed on your PC. A "Full" update contains all the updates released since the last major version of Windows (such as Windows 8.1 or the Windows 10 April 2018 Update). This is typically required after you've just installed or reinstalled the latest version of Windows.

"Delta" and "Express" updates work in a similar way—so much so that Microsoft will be retiring Delta updates as of February 2019, so we'll focus on Express. Express updates are differential—they're generated on demand after Windows Update examines your PC, to contain only those updates not yet installed. This means they're smaller, so are faster to download and install.

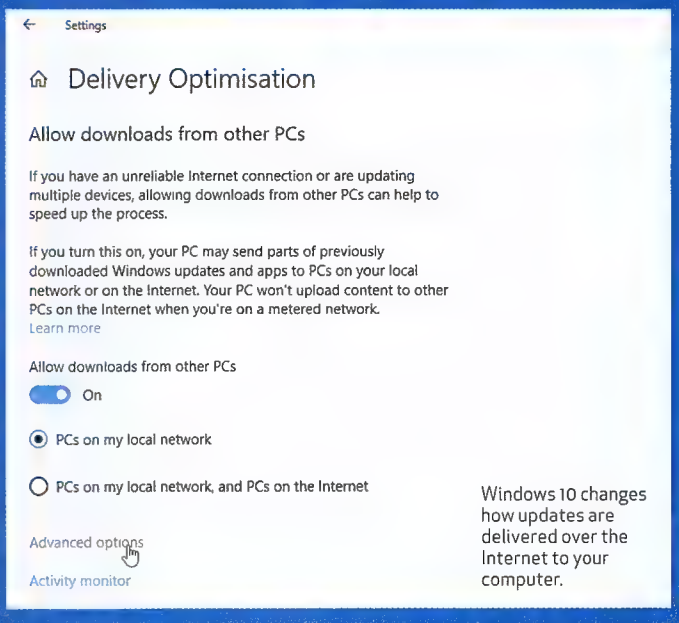
Since 2016, Windows 7, 8.1, and 10 have received updates on a monthly basis—"Patch Tuesday." These contain all security and bug fixes developed over the past month, along with any updates missing from your PC from previous months.

What's Delivery Optimisation?

Windows 10 users need to be aware of a feature known as Delivery Optimisation, which affects how Microsoft delivers updates to PCs over the web. Head to "Settings > Windows Update > Advanced options," and click the "Delivery Optimisation" link. Here you'll see a setting called "Allow downloads from other PCs," which basically means that when the feature is switched on (as it is by default), it's possible to receive your Windows updates using peer-to-peer technology from files stored on other PCs across your network and the Internet. In turn, these files can also be sent from your PC to other computers, too.

Click "Activity monitor" to review how much data is being transferred and how much bandwidth is being used, then click "Advanced options" to set manual limits that should help prevent your connection from becoming overwhelmed.

Better still, switch the feature off completely if you're the only PC user in your home. If not, change the setting to "PCs on my local network," so you can speed up deploying updates to other PCs without having to open them up to the wider web.


Settings
Delivery Optimisation
Allow downloads from other PCs
If you have an unreliable Internet connection or are updating multiple devices, allowing downloads from other PCs can help to speed up the process.
If you turn this on, your PC may send parts of previously downloaded Windows updates and apps to PCs on your local network or on the Internet. Your PC won't upload content to other PCs on the Internet when you're on a metered network.
Learn more
Allow downloads from other PCs
On
PCs on my local network
PCs on my local network, and PCs on the Internet
Advanced options
Activity monitor

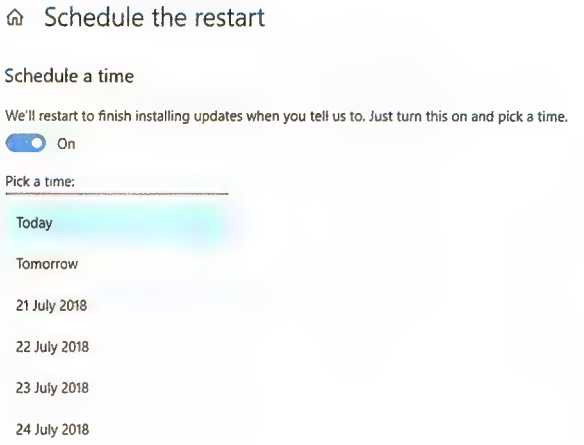
Windows 10 changes how updates are delivered over the Internet to your computer.

Take control of updates

Discover how to use Windows Update, and wrest back control of the update process from Windows 10.

Updating Windows is an incredibly important part of your day-to-day maintenance, but many people put off the updating experience – if they can. This isn't laziness – Microsoft has quite the reputation for releasing patches before they are ready for general consumption, and there are horror stories of Windows installations falling over.

Despite this, in most circumstances it pays to ensure you're at least up to date with the latest security hotfixes, so opting out of updates altogether – even where possible – isn't practical. Let's see what you can do about ensuring the Windows Update process works with you and not against you.



Windows 10 Home users can postpone the inevitable forced restart by up to seven days only.

TAKE BACK CONTROL

When Microsoft released Windows 10, it took control away from the end user running Windows 10 Home, and now forces updates to be installed as soon as they are available and downloaded. At this point, Windows tells you that updates are pending, and prompts you to restart your PC.

It's configured to force a reboot to install updates outside your "active hours"—in other words, when you're not typically using your PC, which is 5pm–8am by default (click "Change active hours" from the main Windows Update settings screen to change them). It means you can't delay an update indefinitely simply by refusing to shut down or restart, but you can defer it slightly: Click "Schedule the restart" next to the "Restart now" button, flick the switch to "On," and you can choose to push back the restart by up to seven days. It's fine as a last resort, but can you really go for seven days without needing to restart or shut down your PC?

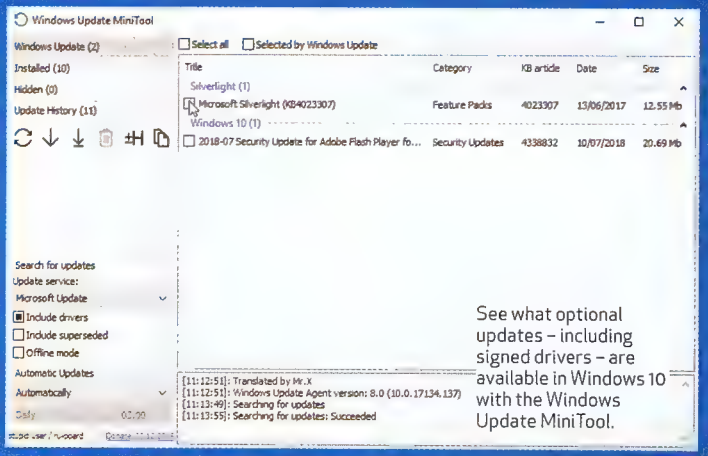
You'll have an easier time if you use Windows 10 Pro: Go to "Settings > Update & Security > Windows Update," and click "Advanced Options." The "Pause Updates" switch allows you to pause updates for up to 35 days – handy if you hear of an update causing problems, and want to put it off.

Optional updates

Windows Update provides "optional" updates that include additional components, such as Silverlight. They also include Microsoft-delivered drivers for a wide range of hardware. Windows 7 and 8.1 users can review and install these via Windows Update, but these updates are hidden from view in Windows 10 – installing driver updates is a hit-and-miss affair, involving going into Device Manager and clicking "Update Driver" within the "Driver" tab of selected devices.

To see what's available – and install it – download the Windows Update MiniTool (**http://bit.ly/2v9BwtK**). Extract its contents, then run wumt_x64.exe (64-bit) or wumt_x86.exe (32-bit), depending on your Windows system type. Click "Check for updates" under "Update History" after verifying "Include drivers" is selected. Select the updates you want, and click "Install Updates" to install them.

It's also possible to hide unwanted updates here – if you're struggling with an update that repeatedly refuses to install, hiding it stops Windows attempting to install it time and time again.

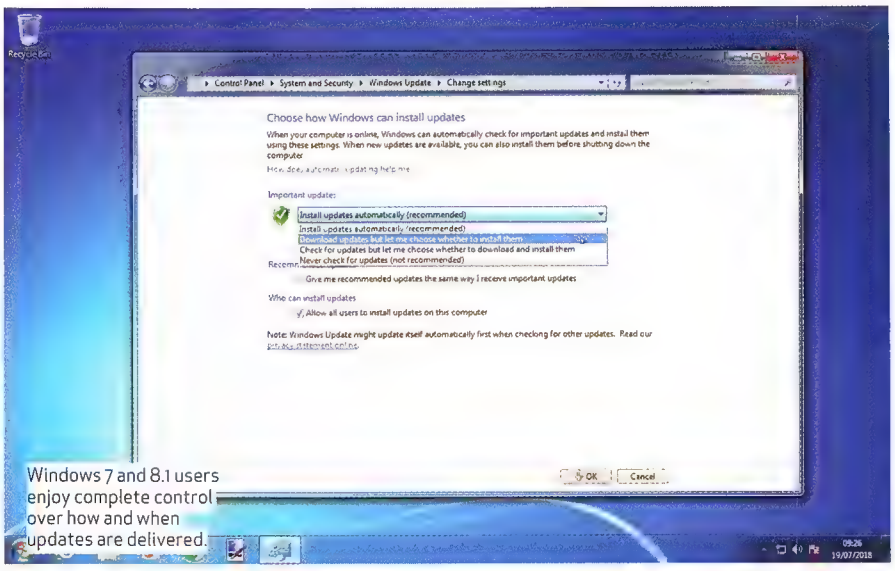


See what optional updates – including signed drivers – are available in Windows 10 with the Windows Update MiniTool.

"It's also possible to hide unwanted updates here – if you're struggling with an update that repeatedly refuses to install."

A better way to prevent updates from getting on your system before they're ready is to scroll down to "Choose when updates are installed." You can delay feature updates by around four months after their release by switching from the "Semi-Annual (Targeted)" channel to "Semi-Annual" via the drop-down menu. You can defer this for up to an additional 365 days via the "Feature Update Defer" drop-down menu. It's also possible to defer quality updates—patches and security hotfixes—for up to 30 days via another drop-down menu. That way, you can avoid exposing your PC to an update that's later pulled for stability reasons.

What if you're running Windows 10 Home? The step-by-step guide below reveals a technique for manually disabling Windows Update that works for the latest April 2018 Update. Note, you should still periodically check for updates – launch the tool and re-enable the service to do so, then disable it again after use.


Control Panel ▸ System and Security ▸ Windows Update ▸ Change settings
Choose how Windows can install updates
Important updates
Install updates automatically (recommended)
Check for updates but let me choose whether to install them
Never check for updates (not recommended)
Give me recommended updates the same way I receive important updates
Who can install updates
Allow all users to install updates on this computer
OK
Cancel
Windows 7 and 8.1 users enjoy complete control over how and when updates are delivered.

WINDOWS 7 AND 8.1

If you're still using Windows 7 or 8.1, you remain in full control of the process. Open "Control Panel > Windows Update," where you'll see a screen telling you how many updates are waiting to be installed. Click "Check for updates" to refresh this search at any time. Updates are divided into two types: important and optional. You're shown how many of each are available – click the relevant hyperlink to view and select which ones to install using the check boxes. For more information about a specific update, select it for a summary, then click "More information" for a full description online.

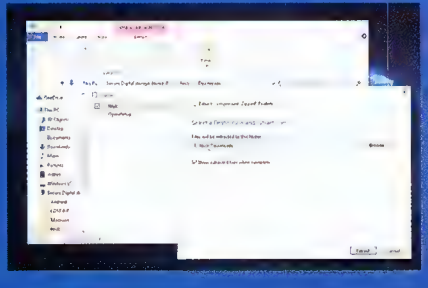
You'll also see a status about whether the update has been downloaded or not, and whether it's ready to be installed on your PC. This status ties into how you've configured Window Update. Click "OK" to return to the main screen, then click "Change settings" to control when and what updates are deployed to your computer.

By default, updates are installed automatically either at a set time or when you next reboot, but if you want to pause before installing them, we recommend choosing "Download updates but let me choose whether to install them." You can also review available updates before downloading them, or switch the feature off entirely – we don't recommended doing this, however, since both Windows 7 and 8.1 are still supported by security hotfixes, so should be kept up to date.

You'll also see a box allowing you to opt out of automatically receiving "recommended" updates alongside critical ones. Unchecking this box means recommended updates like the .NET Framework Tool are moved to the "Optional" category, where they're italicized to make them stand out (see the "Optional updates" boxout opposite).

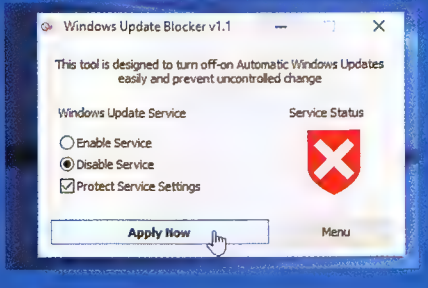
Switch off Windows Update

How to switch off Windows Update



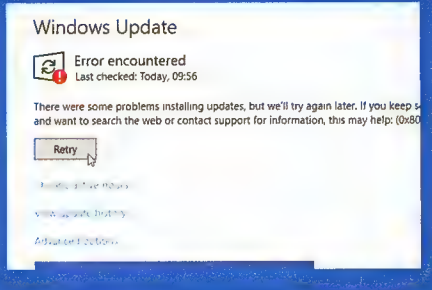
1 DOWNLOAD AND RUN

Download the Windows Update Blocker tool from **www.sordum.org/9470/** – the grey "Download" button is just above the "Related Posts" section. Once downloaded, right-click "Wub.zip" and choose "Extract All." Next, double-click "Wub.exe" inside the extracted folder to launch the program.



2 SWITCH OFF SERVICE

A small window appears. Select "Disable Service," and verify that "Protect Service Settings" is checked. Click "Apply Now," and the status should change to a red shield with an X, indicating it's been disabled. Reboot your PC – note any updates already awaiting a reboot will still be installed.


Windows Update
Error encountered
Last checked: Today, 09:56
There were some problems installing updates, but we'll try again later. If you keep
and want to search the web or contact support for information, this may help: (0x80
Retry

3 CHECK FOR UPDATES

After rebooting, reopen Windows Update Blocker and verify that the service is still disabled. Go to "Settings > Update & Security > Windows Update," where you should find everything appears normal, but click "Check for updates," and you'll see an error, indicating it's been disabled.

Troubleshoot updates

Sometimes the worst happens, and an update goes wrong – just follow these tips to get out of trouble.

Ideally, Windows Update should be virtually invisible – other than alerting you when updates are ready to be installed, and while they're being configured on startup.

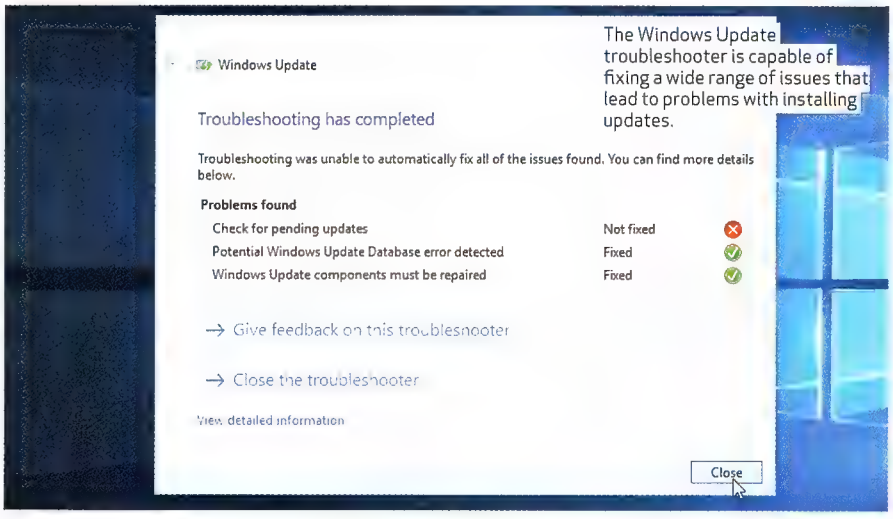
In the real world, we all know better, of course. Some Windows updates might require two or three attempts before finally installing, while others may stubbornly refuse to install, period. Windows Update might even stop functioning completely, or your PC may suddenly refuse to reboot after you've installed the latest updates. So, what's the solution?

GENERAL TROUBLESHOOTING

If Windows Update refuses to work correctly – it throws up errors when you attempt to install or scan for updates, for example, or you're struggling to install a specific update – start by running the Windows Update troubleshooter. In Win 10, go to "Settings > Update & Security > Troubleshoot," click the "Windows Update" link, and click "Run the troubleshooter." Older versions hide the troubleshooter under "Control Panel > System and Security > Action Center > Troubleshoot common computer problems."

When the wizard opens, click "Advanced" and choose "Run as Administrator," before clicking "Next" (Windows 7/8.1 only). Wait while the tool scans for issues – if it finds and fixes any, click "View detailed information" if required, to find out more, then click "Close," reboot, and try again. If the fix involves installing pending updates, but it's those updates refusing to install that is causing the problem, click "Skip this fix" to keep searching for other potential issues.

If the problem persists, you may need to perform more drastic steps.


Windows Update
Troubleshooting has completed
Troubleshooting was unable to automatically fix all of the issues found. You can find more details below.
Problems found
Check for pending updates
Not fixed
Potential Windows Update Database error detected
Fixed
Windows Update components must be repaired
Fixed
Give feedback on this troubleshooter
Close the troubleshooter
View detailed information
Close

The Windows Update troubleshooter is capable of fixing a wide range of issues that lead to problems with installing updates.

Windows won't boot!

It's rare for updates to screw your system up so much it can no longer boot into Windows. After several failed attempts, Windows should give you the option of booting into Safe mode, or bring up the recovery menu. From here, try "Startup Repair" or "System Restore" to roll your PC back to the restore point taken before the update was installed. Note: This may not be an option if you're running Windows 10 and didn't switch System Restore back on after installing the April 2018 Update.

Other options involve recovery media – if you regularly back up using a tool such as Macrium Reflect Free (**www.macrium.com/reflectfree**), roll back to your last backup using its boot media. Or you could boot from your Lazesoft Recovery Suite rescue media (**http://bit.ly/2LtlgPq**), and try its Windows Recovery tool. If it fails, use the Data Recovery component to save your data, or take a disk image before booting from your Windows rescue or installation media, and try a repair install; this involves installing Win 7 over the top of itself, or performing an "upgrade install" with Win 8.1 and 10 boot media.

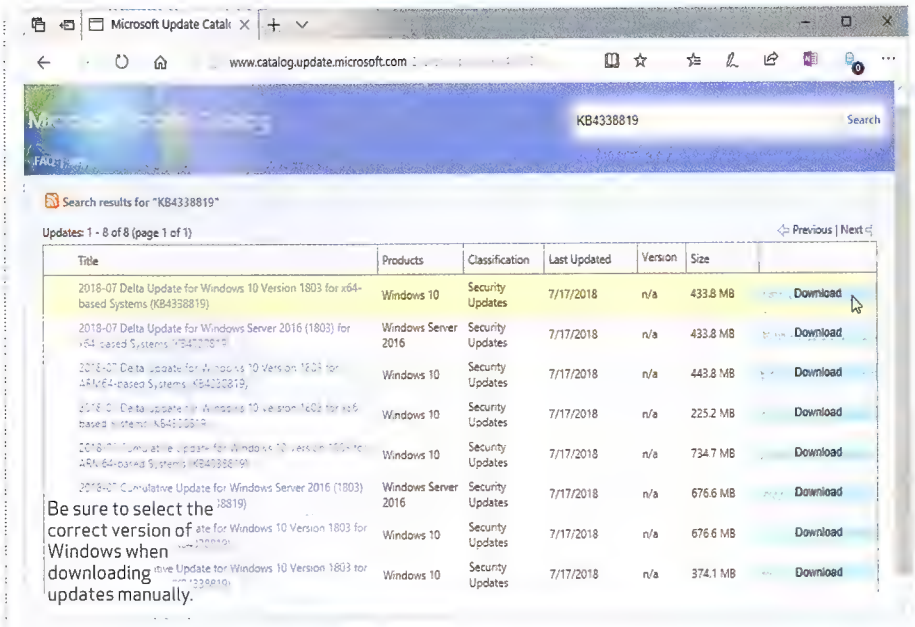
System Restore – if it's working and accessible – is your easiest route to undoing a catastrophic failed update.

The "Reset Windows Update" guide below explains how you can use the Windows Repair Tool to get around this – download and install the tool (or extract the portable version) from **www.tweaking.com**. It will attempt a deeper fix via Safe mode.

Often, the problem isn't with Windows Update itself, but a specific update that refuses to install. You may get advanced warning—a message during reboot that Windows is reversing a failed update—or your PC may keep attempting to install updates after every reboot. If the problem persists over two or three reboots, it's time to take further action.

Check the status of updates via the Windows Update tool. Simply click "View update history," where you'll see a list of previously installed updates and whether they were successful or not. If there are multiple updates failing, it's likely only one of them is the culprit. Windows 8.1 and 7 users can click to review updates, then select updates one at a time. This may be enough in itself (four stubborn updates on our Windows 8.1 PC all installed singly with no issues, having failed to install together), or it will at least narrow down your search to the specific malfunctioning update.

Another possible fix is to download and install the problem update manually. Search for the update number (including KB) at **www.catalog.update.microsoft.com**. You're given a list of matches based on Windows version, plus system architecture—x64 is for 64-bit versions of Windows, x86 for 32-bit. Download the file, double-click it, and follow the displayed instructions to install it.



Be sure to select the correct version of Windows when downloading updates manually.

If this doesn't work, then you'll need to dig deeper. Any failed updates are accompanied by an error code in Windows 10; Windows 8.1 and 7 users need to double-click a failed update to review an error report including the error code. Older versions of Windows also provide a "Get help with this error" link, although this usually fails to yield any meaningful results.

Instead, make a careful note of the error code and the update KB number. Google the code – try it with "Windows Update," your version of Windows, the KB number, or just on its own to see what you find. Ignore ads and focus on genuine websites, including reputable sources such as **https://answers.microsoft.com**. Focus on newer results first—particularly if they correspond to your specific KB number.

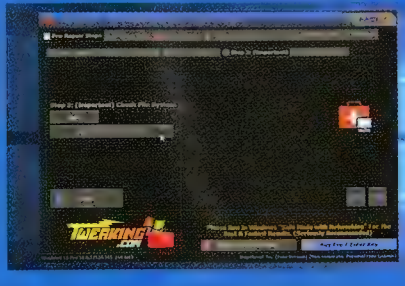
With a little luck, you'll stumble upon a solution that's been found by other users – the Windows user community is particularly good with sharing and helping. ■

Reset Windows Update

How to reset Windows Update

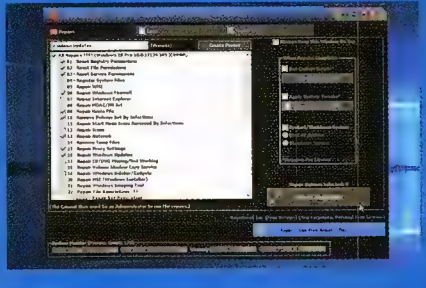
1 USE SAFE MODE

Press Win-R, type "msconfig," and press Enter. Switch to the "Boot" tab, and check "Safe boot," selecting "Network." Click "OK > Restart." Once in Safe mode, launch Windows Repair (**www.tweaking.com**) and work through the basic checks – ignore the power reset if your PC is otherwise OK



2 PERFORM PRE-CHECKS

The other three steps – pre-scan, disk check, and System File Checker – are all essential in case your Windows Update problem is linked to disk errors or has missing or corrupt system files. Work through them, rebooting where prompted, then returning to that point in the program



3 APPLY REPAIRS

Once done, click "Backup" to back up the Registry, and "Create" to create a system restore point. Next, you're prompted to open Repairs or select a preset – select "Preset: Windows Update." Click "Start Repairs." When done, return to msconfig, and uncheck "Safe boot" before rebooting

System News

Intel is so successful it hurts. Mark Williams looks at how Intel's CPU shortage will impact the market over the coming months.

Intel's 14nm production lines have reached maximum capacity. In fact, they're over capacity.

So delayed is Intel's 10nm node, that it's had to push product schedules back, move focus to higher profit margin parts and to even push some chips back up onto the old 22nm process to clear manufacturing throughput.

The way Intel typically operates is that CPUs get moved onto the new manufacturing node when it comes online, then less profitable chips (such as NICs and motherboard chipsets) get moved down to the now well-established outgoing node. This keeps those parts just one generation behind and costing less to produce than the more expensive CPUs that helped refine the manufacturing process.

So confident was Intel that the 10nm issues would be solved by now that it moved the motherboard chipsets down to the current 14nm++ technology from 22nm before the CPU manufacturing had switched over to 10nm. With everything now being made on 14nm++ and an unexpected uptick in demand for PC products of late, there simply isn't enough 14nm++ manufacturing capacity to support making everything at once to the volumes required.

So, Intel has decided to prioritise higher margin CPUs in the form of its Xeon and Core products at the expense of its lower-end brands like Pentium.

It also forced Intel's hand with the 9th generation CPU line-up, making it the fifth in a row on the 14nm node.

It will also move some chipset manufacturing back up to 22nm – for example the H310 chipset, which will be re-spun to 22nm and come out branded as a H310 v2.0.

All this has resulted in a CPU supply shortage of around 5-10% that, for the moment, mostly only means higher priced CPUs as supply gets squeezed. As a specific example, the i7-8700K has increase in price by some $65 over the past month, putting it a full $120 (or 25%) above AMD's most expensive competitor, the Ryzen 7 2700X. And the 8700K certainly isn't 25% faster than the 2700X – it's around half that in best case scenarios. Thus, the price to performance metrics start to look bad for Intel.

When asked if the Intel CPU shortage might result in a higher ratio of AMD systems in their PC offerings mix, Gennady from Scorptec replied, "Our offering would remain similar, but customers may uptake AMD systems more simply because they are more cost effective currently."

With John from TI Computers and Jaimie Ianson from Leader Computers both saying that with some minor operating changes they're weathering the shortage well; the fact is that if you want an Intel-powered system between now and mid next year when the shortage is expected to end, you'll be paying a premium for the privilege.

It's certainly worth considering AMD Ryzen products during this period, as they'll offer even better value for money in comparison. Particularly when AMD rolls out the Zen 2 CPUs early next year made on TSMC's 7nm production node, which is reportedly very similar to Intel's troubled 10nm.

For the first, this could give AMD time a manufacturing advantage over Intel. And without supply constraints, it could see AMD take back a large percentage of the market share in the first half of next year.

SHOP TALK

How do you foresee Intel's extended CPU shortage impacting your business over the next several months?

Jaimie, Leader Computers:
"We are seeing price rises across the popular models of i5 and i7 as stocks tighten even further, and it looks like this situation could run well into the first quarter next year. This news bodes well for AMD with Ryzen numbers climbing in the mid-range PC market.

We have also seen the shortages affect laptop supply and prices, with most tier one laptops being delayed or copping a price hike and have even had some delays with a few models of our own Leader Laptops recently.

My advice to prospective buyers now would be to carefully compare the Intel offerings with their AMD counterparts, as the Ryzen platform is offering outstanding value right now."

Gennady, Scorptec:
"I feel that it's having a very negative impact on business overall. When we can get stock, the pricing is constantly on the way up due to shortages, so they are becoming more and more expensive and unfavourable to customers. It is not only impacting just CPU sales alone but also our own system building as both the supply and pricing is extremely inconsistent. It is also not helping with the recent Nvidia graphics card launch for those customers looking to buy whole new systems, now it is not only difficult to get the GPU but the CPU as well."

John, TI Computers:
"The Intel CPU shortage leads to the need for bundle purchases, where the CPU can only be ordered as a set with a motherboard. Fortunately, our business focuses on custom and builds to purpose instead of individual sales, thus it has not impacted us much. For the assurance of a smoother delivery of our everyday business systems, we have started to offer USFF systems as an alternative. With this change in place, our business operates quite comfortably without much impact from the Intel CPU shortage."

Market Watch

Mark Williams assesses a sampling of PC systems available this month.

Scorptec Vengeance RTX 2080 Ti Gaming PC

$4,899 | TINYURL.COM/APC461-SCORP

A big price for big performance. This is the cost of wrapping a system around Nvidia's latest and greatest GTX 2080 Ti graphics. The undisputed king of GPUs demands only the best system, and a big wallet to match. The best gaming CPU on the market with its high clock speeds will keep the monster GPU well fed, allowing you to push those shiny ray-traced graphics out at 4K resolutions or 144Hz+. Being water cooled and matched with higher speed RAM will allow for some reasonable overclocking explorations. The 32GB of RAM is perhaps overkill; some money could have been saved sticking to 16GB, but this will give productivity freedoms plus provide some future proofing.

KEY SPECS: CPU: Intel Core i7-8700K; Cooler: Corsair Hydro H115i Pro RGB; Motherboard: Asus ROG Strix Z370-E; Graphics: Zotac AMP GeForce RTX 2080 Ti 11GB; Memory: Corsair Vengeance RGB 32GB 3000MHz DDR4; Storage: Samsung 970 EVO 500GB M.2 SSD, Seagate BarraCuda 2TB HDD; PSU: Corsair TX750M 750W; Case: Corsair Obsidian 500D

Umart Chronos RTX 2080 Ryzen 2700X Gaming PC

$3,491 | TINYURL.COM/APC461-UMART

This one's GTX 2080 is a GTX 1080 Ti killer, beating it by 6-8% on average and giving it the ability to run 4K games at 60fps. The CPU is AMD's best, and while it hasn't the top-end MHz speed of Intel chips, as long as you keep your games GPU-limited using high resolutions and effects, this won't hold the GPU back all that much. Plus, it has the benefit of being an eight-core, 16-thread multithreading beast that will chew through any productivity work faster than any current consumer Intel chip. Matched with 32GB of RAM, this system is quite capable of completing serious work tasks, not just gaming. The 500GB NVMe SSD is nice, but comes at the cost of no HDD for mass storage.

KEY SPECS: CPU: AMD Ryzen 7 2700X; Cooler: Wraith Prism RGB; Motherboard: MSI X470 Gaming Pro Carbon; Graphics: Gigabyte RTX 2080 Gaming OC; Memory: Ballistix 32GB RGB DDR4 3000MHz; Storage: Samsung 970 EVO Series 500GB M.2 SSD; PSU: Corsair 850W HX850; Case: Fractal Design Define R6

PC Case Gear Intel NUC Mini PC i7-8705G

$1,099 | TINYURL.COM/APC461-PCCG

Remember Intel's Core i7-8xxxG series processors? The chips that made pigs fly, because both an Intel CPU and an AMD GPU were slapped onto the same substrate, making for a collaborative effort no one thought ever possible? Well, you can buy this piece of history in the most powerful NUC series to date. At the heart of this particular NUC is the Intel Core i7-8705G. Which sports an 8th-gen quad-core hyperthreaded CPU running at up to 4.1GHz plus an AMD Vega M GL GPU with 20 compute units running at up to 1011MHz. It's the lowest end Hades Canyon NUC, but with it only missing 100-200MHz compared to the top SKU, and four GPU compute units, the cheaper price and lower 65W TDP make this a more desirable choice if system noise levels are of importance to you.

KEY SPECS: CPU: Intel Core i7-8705G; Cooler: OEM; Motherboard: OEM; Graphics: AMD Vega M GL; Memory: None; Storage: None; Power Supply: OEM

TI Computers Asus UN68U Mini PC

$1,159 | TINYURL.COM/APC461-TICOMP

This mini PC is a NUC class product that has the RAM and SSD included for you. With 8GB of RAM and a 256GB SSD, it's perfectly suited to most common tasks. The 3.4GHz quad-core hyperthreaded CPU only has a base clock of 1.6GHz, so you'll be relying on the turbo clocks for responsiveness. It basically has too many cores for its measly 15W TDP, so don't go loading this up too often with heavy loads, as you will cut CPU performance per thread by more than half if it can't maintain those turbo speeds. With four USB 3.1 ports, Wi-Fi AC and HDMI and DisplayPort outputs, this system is well suited as a media streamer/player, web browser for your TV, or for simple office document tasks and even point of sales systems where a small, quiet and not very powerful PC is desired.

KEY SPECS: CPU: Intel Core i5-8250U; Cooler: OEM; Motherboard: OEM; Graphics: Intel HD Graphics 620; Memory: 8GB DDR4 2400Mhz; Storage: 256GB M.2 PCIe NVMe SSD; PSU: OEM; Case: OEM

PC blueprints

The *APC* team's picks for a part-by-part perfect PC build to suit your budget.

PARTS LIST

PART		PRICE
CASE	BITFENIX NOVA TG	$75
PSU	450W CORSAIR CX450	$69
MOBO	ASROCK A320M-HDV	$75
CPU	AMD RYZEN 3 1200 **NEW**	$145
GPU	GIGABYTE GEFORCE GTX 1050 2GB **NEW**	$199
RAM	8GB (2 X 4GB) KINGSTON HYPERX 2666MHZ	$129
SSD	120GB KINGSTON A400 120GB 2.5 SSD	$38
HDD	1TB SEAGATE DESKTOP ST1000DM010	$65
OS	UBUNTU DESKTOP LINUX 18.04 LTS 64-BIT	$0
APPROXIMATE PRICE:		$795

We'd settled on the Ryzen 5 2400G as our processor of choice for the budget build earlier, and if you're after a standard rig that can have a fair shot at old video games, while doing basic workloads, the G's for you. But we're not ones to rest on our laurels, so we've swapped it out for something a little more exotic. As GPU prices are continuing to plummet, GTX 1050s are now hitting that sub-$200 price point. They don't offer the same impressive price-to-performance ratio as the likes of the GTX 1060 (and we always recommend you stump up for that if you can), but they're still pretty impressive nonetheless. We're talking at least 40fps in most AAA titles. To go with that, we've picked a Ryzen 3 1200. Although a little long in the tooth, its 16 PCIe lanes, versus the 2400G's eight, make it a better performer with a dedicated GPU. And with a solid four cores, it beats the competition at the same price, too.

PARTS LIST

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	$129
PSU	550W EVGA SUPERNOVA 550 G3 80+ GOLD	$149
MOBO	ASUS ROG STRIX B450-F GAMING	$209
CPU	AMD RYZEN 7 2700 **NEW**	$379
COOLER	CORSAIR HYDRO H100I PRO 240MM RGB AIO **NEW**	$160
GPU	ZOTAC GEFORCE GTX 1070 TI **NEW**	$659
RAM	16GB (2 X 8GB) G.SKILL RIPJAWSX 2133MHZ	$219
SSD	250GB SAMSUNG 970 EVO M.2 PCIE SSD	$138
HDD	SEAGATE BARRACUDA 1TB ST1000DM010	$65
OS	WINDOWS 10 HOME 64-BIT OEM	$145
APPROXIMATE PRICE:		$2,252

We're reworking where our mid-range sits, to try to position it between a PC that is capable of 1080p gaming, and one optimised for 1440p. At least initially – once this issue's over, we'll revert to type, and inevitably continue to shift the pricing around to try to get the spec as cheap as humanly possible (not that we haven't done so already). So why the upheaval? Well, it all falls down to those GPUs, and trying to find a nice balance between price and performance. The GTX 1070 Ti, despite being somewhat of a mixed-bag GPU, is a fairly respectable card. It performs almost as well as a GTX 1080. Coupled with a solid processor, the Ryzen 7 2700, our overclocking processor of choice, and a decent all-in-one cooler, and what you're left with is an insanely cost-effective, 1440p gaming machine. In fact, looking at the spec, it's not too dissimilar from the Masterclass rig we did this very issue. The only real difference being the storage and motherboard.

UPGRADE OF THE MONTH

Enermax Liqtech TR4 II

$140 | WWW.ENERMAX.COM

A cooler? For "Upgrade of the Month?" Are you mad, *APC*? Probably. But hear us out: This thing is darn impressive. We were apprehensive about using this bad boy at first, but after spending some time with it, we can honestly say it's one of the better AIOs we've had the pleasure of using with Threadripper. Whether that's because we have it set up with quad-Noctua NF-F12s in push-pull, because the CPU block covers 100% of the IHS, or because it's simple and easy to install, it's just really good. And finding a cooler that can take on a 16-core processor, and have it overclocked to 4.3GHz, nearly hitting that silicon limit, across all those cores, without reaching higher than 82°C, is a plus in our book.

Even the radiator looks stylish, and it comes with a 2-year parts and labor warranty. OK, we'll stop gushing about it now — but seriously, if Threadripper is your thing, try giving this beauty a shot. At least for anything at or under 16 cores.

"Why no RTX 2080? Well, to be honest, we're just not willing to recommend a GPU that effectively won't provide any more performance, for $500 more"

Several changes come into play this month in our Turbo build. So, why the big change-up? Well, it all starts with our Intel processor of choice, the Core i9-7900X. It's the Intel processor to go for right now: 10 cores, 20 threads, high clock speed, solid performance. Delid it, and you've got yourself a pretty chilly processor, too. Thing is, its price jumped all the way from $895 to $1,100. That's a no-go for us, as it's no longer competitive. The solution? Well, because Threadripper+ is now readily available, and pretty comfortable in both games and extreme workloads, we're happy to suggest it again over the 7900X.

Single-core performance is up, memory latency down, and overall clock speed increased. This does mean we've had to swap the motherboard out (annoyingly for one that's $120 more), but we've leveraged costs elsewhere, opting for the same cooler we were given to test the 2950X, a new memory kit at a higher frequency than last issue (for less cash) and a somewhat more substantial graphics card.

Storage has come down a touch, too, so overall we're better off, ironically, and there's an additional six cores and 12 threads to play with, too. Why no RTX 2080? Well, to be honest, we're just not willing to recommend a GPU that effectively won't provide any more performance, for $500 more, on the pretense that some games might have slightly better reflections at some point in the future.

PARTS LIST

PART		PRICE
CASE	NZXT H700I	$173
PSU	CORSAIR RM750X MODULAR GOLD	$110
MOBO	ASUS PRIME X399-A **NEW**	$300
CPU	AMD THREADRIPPER 2950X **NEW**	$899
COOLER	ENERMAX LIQTECH TR4 II 240MM RGB **NEW**	$140
GPU	MSI GEFORCE GTX 1080 TI ARMOR 11GB	$675
RAM	32GB (4X 8GB) G.SKILL TRIDENTZ 3200 **NEW**	$316
SSD	512GB SAMSUNG 970 PRO M.2 NVME	$200
HDD	2 X 2TB SEAGATE BARRACUDA ST2000DM006	$120
OS	WINDOWS 10 HOME 64-BIT OEM	$100
APPROXIMATE PRICE:		$3,033

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

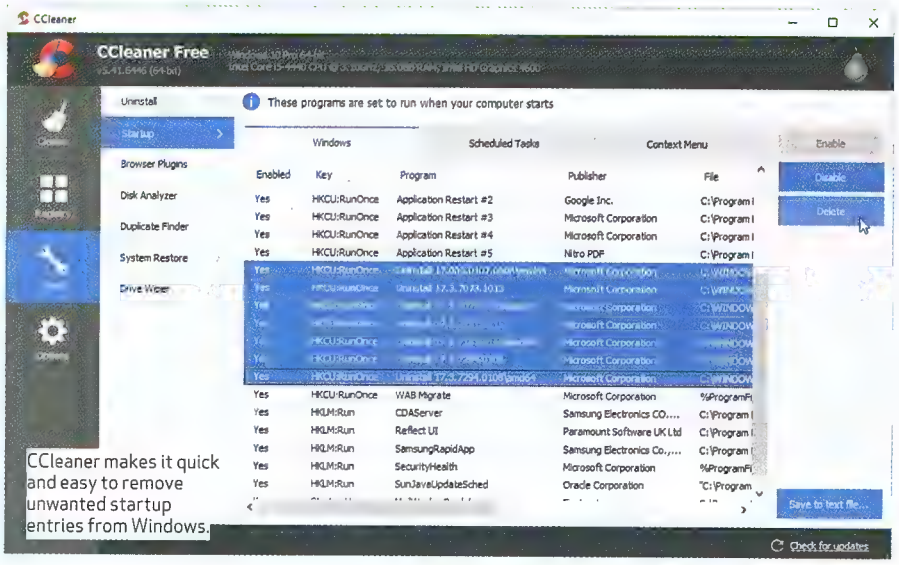
WINDOWS

STRANGE ENTRIES APPEAR AT STARTUP

I've noticed a strange phenomenon at startup – command-prompt windows briefly flash up and disappear. I ran AutoRuns and have discovered a long list of entries marked 'Uninstall 17.x.x.x' listed as 'Windows Command Processor'. What are these, and is it safe to delete them?
Jackie Kent

They're all linked to OneDrive. They're small scripts designed to clean up old versions of OneDrive after it's updated. They're supposed to delete a redundant folder, then remove themselves from startup, but often they get left behind and the entries start to mount up.

This is a bug with OneDrive itself, but despite several references online, there's no definitive way to stop it happening. Thankfully, you can at least clean them out periodically using AutoRuns or a similar tool such as CCleaner (look under Tools > Startup where you can select all the offending entries and delete them with one click).
Nick Peers



CCleaner makes it quick and easy to remove unwanted startup entries from Windows.

NETWORKING

ADD NETWORK IP TO WINDOWS TRUSTED ADDRESSES

How do I stop a 'These files might be harmful to your computer' message appearing when copying files across my network? I trust the PC in question.
Jack Quince

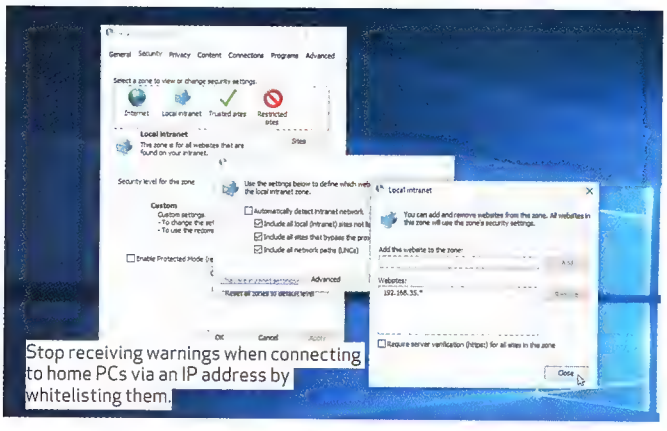
This happens when you type a networked PC's IP address into the File Explorer address bar to connect to it rather than clicking (or typing) its computer name – which is sometimes the only way it'll enable you access it. If you are unable to connect to the PC using its name, open the Internet Options Control Panel – in Windows 10, type 'internet options' into the search box to access it. Now switch to the Security tab, select 'Local intranet' and click Sites followed by Advanced. Add '192.168.0.*' to the zone, replacing '192.168.0' with the first three digits of your network's IP address. Click 'Close' > OK > OK. Restart your PC and you should find the warning no longer appears.
Rob Mead-Green

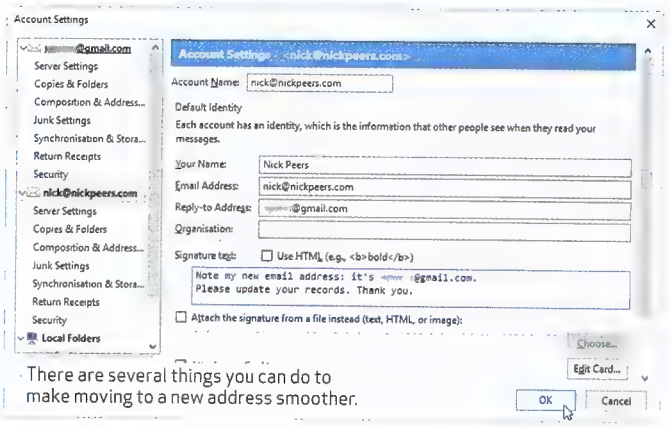
EMAIL

MIGRATING TO A NEW EMAIL ADDRESS

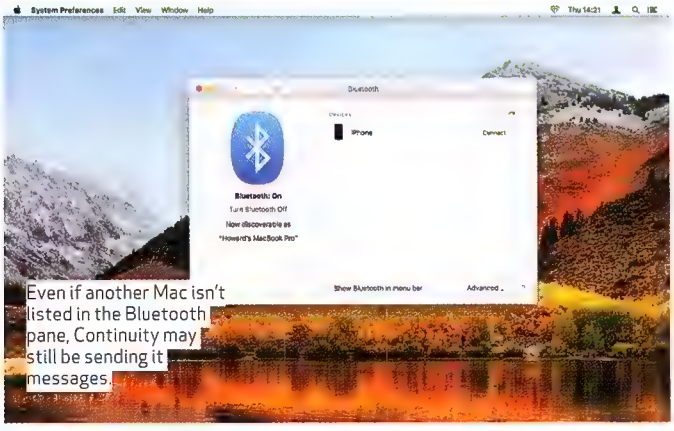
After ten years of having to change email address whenever I've moved to a new Internet provider, I've decided to bite the bullet and get a single Gmail address that I'll be able to take with me. The problem is, I've got around 60 contacts to tell about my new address. What's the best way to do this without causing them (or me) too much disruption?
Martin Oldfield

There are two ways to help nudge people towards your new email address. The first is to ensure any replies you send to emails that have been delivered to your old address automatically go from your new

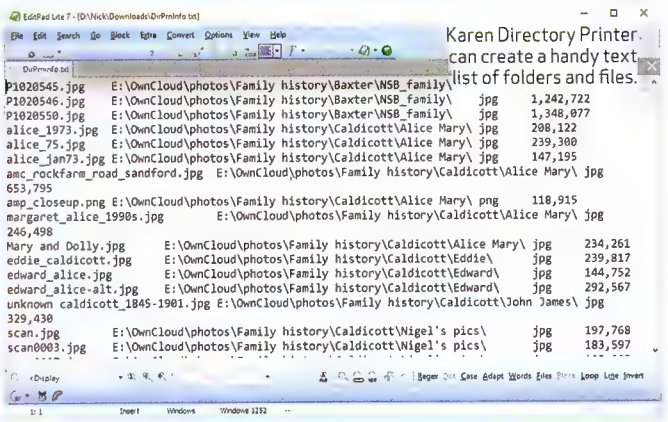

Stop receiving warnings when connecting to home PCs via an IP address by whitelisting them.



There are several things you can do to make moving to a new address smoother.



Even if another Mac isn't listed in the Bluetooth pane, Continuity may still be sending it messages.



Karen Directory Printer can create a handy text list of folders and files.

address. With Gmail this is simple enough if you're now using your web browser to collect your mail.

If you've not already done so, route your old email address through Gmail by clicking the Settings button and choosing Settings > Accounts and Import, then clicking 'Add an email account' under 'Check email from other accounts'. This means all emails to sent to your old address will show up in Gmail and when you click Reply, Gmail is the account used to carry the conversation on going forward.

If you're using a different email client – Mozilla's Thunderbird, say – then assuming both accounts are set up, right-click your old account in the Folder Pane and select Settings. Simply enter your Gmail address into the 'Reply-to' address field and click OK.

If people persist in using your old address, go back to your old account's settings in Thunderbird and add a signature gently reminding them to update their records.

Alex Cox

MAC

BLUETOOTH CRISIS

Whenever I use my new MacBook Pro near my iMac, the latter's Bluetooth starts to play up. At first, it loses its wireless keyboard and Magic Trackpad 2, which then reconnect. It often worsens to the point where I have to plug them both in, using their charging leads. The iMac is running macOS 10.12.6 and uses an Ethernet connection, with Wi-Fi turned off. The MacBook Pro runs 10.13.4, connects over Wi-Fi, and carries on working fine.

Harry Rich

What's most likely to be happening is that the MacBook Pro is trying to talk to your iMac due to their close proximity. That behaviour is extensively employed by the Continuity set of features; these are intended to make it easier for you to use multiple Apple devices together – for example, Handoff for moving a task from your iPhone to your Mac (or vice versa), and AirDrop for sending files or other info directly between devices, even when there's no local area network available to facilitate this.

These features use Bluetooth to detect the presence of nearby devices, and establish a direct connection between them using Wi-Fi. As your iMac has its Wi-Fi turned off, this can't function fully, causing the connection to drop, then start all over again.

This combines with a long-standing problem with some Macs running El Capitan or Sierra, whose Bluetooth has never been entirely stable: many people still suffer from sporadic spontaneous disconnect-reconnect cycles. When that wobbly system is then bombarded with proximity-based attempts to connect, it can be sufficient to break its Bluetooth service altogether.

Hopefully, Apple will fix this in a future update. Until then, you have a choice between turning off Bluetooth on the MacBook Pro, or turning on Wi-Fi on the iMac, which may allow the two computers to connect fully for Continuity features and for everything to settle down again.

WINDOWS

SYSTEM RESTORE POINTS TAKING DRIVE SPACE

I've started getting low drive space errors on my laptop with a 128GB SSD. I scanned the drive using TreeSize Free and it reveals that half of my drive space has been taken up by the System Volume Information folder. Can you explain what this is, and whether or not it's safe to delete?

John Cotterill

The System Volume Information Folder is where all your System restore points are kept. In this case, it sounds as though it's been configured to take up to half your drive space, which is obviously a problem when you only have 128GB of storage on your laptop to start with – you can verify that this is the case by typing 'system restore' into the search box, then clicking 'Create a restore point'. Select your C drive and click Configure. We suspect the slider there is set to 50 percent or more.

The obvious solution is to reduce this – you shouldn't need more than 5-10 percent of drive space reserved for System Restore since older restore points aren't reliable and you only need to keep a handful in case of disaster.

To free up space on your laptop, nudge the slider back down to no more than ten percent and then click Apply – the oldest System Restore points will now be removed, and you'll get 50GB of storage back, and no more low drive space errors!

Rob Mead-Green

WINDOWS

COPY DIRECTORY LISTING TO TEXT FILE

What's the simplest way to output the filenames inside a folder to a text file?

Lynda Franklin

You could use the 'dir' command via the Command Prompt, but a much more user-friendly and configurable solution lies with Karen's Directory Printer, which you can download and install from **www.karenware.com/powertools/ptdirprn** – read on to find out how to use it.

1 Once you've installed Karen Directory Printer, type 'directory' into the search box and click Directory Printer to launch the program. Switch to the 'Save to Disk' tab and use the 'Select a Folder' box to choose the folder you wish to output to text.

2 Use 'Save Options' to choose whether to include folder and/or file information, along with the contents of sub-folders as well as hidden and system files. Use the File Info and Folder Info tabs to select which items to include in the text file.

3 Use the File Filter drop-down menu to include only certain file types in your list – click 'Edit…' to see what's included or to create your own filters. Use the 'Sort Files By' option to set an order for the files. We also suggest ticking both 'Omit…' options.

4 When you're ready, click 'Save to Disk…' and choose where to save the text file. Wait while the list is generated – when you're done, browse to the folder you created and double-click the file to view your file list (and copy it to another document).

Cat Ellis

Calibrate your computer monitor

Anyone who sits looking at a monitor all day, then perhaps goes home and looks at another, will know one thing about them: Two screens are rarely the same. Ian Evenden

One may be brighter than the other, or have more yellow in its output, and while these discrepancies may be forgivable in a simple office machine, if you have a twin-screen setup, you'll want the displays to output the same brightness and color temperature. This is especially true if you've mixed and matched your monitors, because the Asus 4K model on the right you got for gaming may not match the BenQ 1080p screen on the left you use for Google Docs and email.

The color output of your screen becomes an issue if you're printing, too. While no amount of ink on paper, which is dependant on the light it reflects, can reproduce the color intensity of an image backlit by thousands of tiny glowing cells, a calibrated screen can at least ensure you don't end up with a print that's wildly darker or lighter than you expected—especially annoying if you've ordered hundreds from an online service.

We're using the lowest-cost Spyder calibration device here, but if you want more control over your screen, more expensive models are available. You can also use Windows 10's built-in controls, and we'll go over those, too.

A

1 TURN ON YOUR SCREEN

This may sound obvious, but it's a good idea to do something else for half an hour before beginning the calibration process. This allows the screen to warm up [Image A], and display its true colors—it may be darker and less vibrant when it's just switched on. You'll also want to use each screen's on-screen display to reset its brightness and contrast to neutral levels, as if it had just come out of the box. This is also a good time to dig out the exact make and model of your screen—you might need it later.

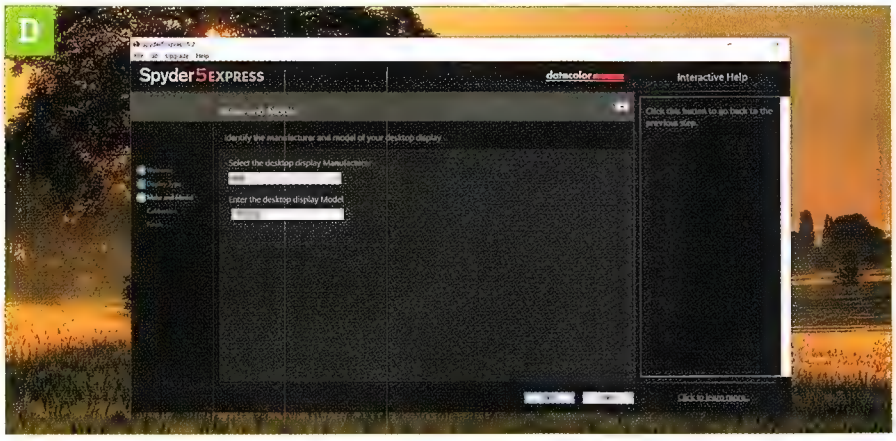
2 ENTER THE SPYDER

If you're using a calibration device, now's the time to take it out of its box. We're using a Datacolor Spyder 5 Express [Image B], but other brands are available. It's an entry-level device, and will calibrate your screen to an industry standard color reference, though it neglects to say what that standard is. This means you don't get a choice of calibrations based on what looks best for you, Spyder knows best, and you accept what it gives you. Of course, this doesn't mean you can't nudge the brightness up a bit once it's finished, but this may come back to bite you when you start printing. If you choose to upgrade your Spyder software to a more expensive version, you get a lot more choice about how the calibration is applied, but we're using the entry-level version here.

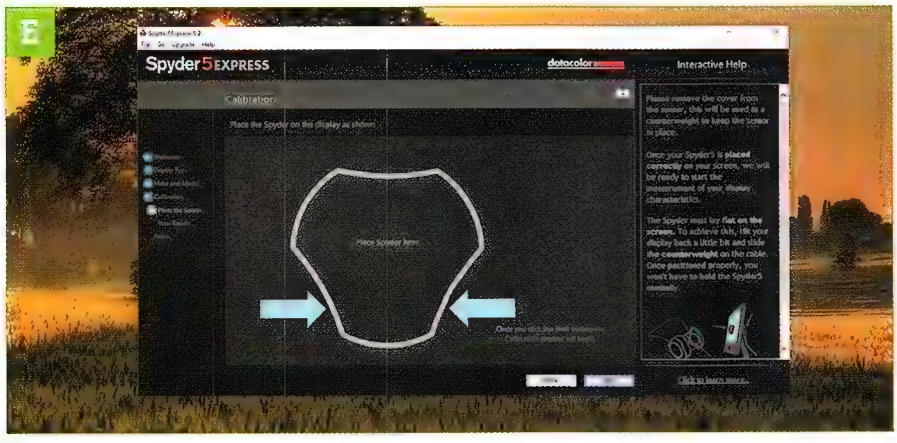
B

C

D



E



3 TAKE OFF THE LENS CAP

There's a lens cap on the Spyder device. We failed to remove it the first time, and wondered why it didn't work. Under the cap is something that looks rather like a plastic honeycomb, with an ambient lighting sensor on the other side. Install the software that comes with the device, and make sure there's a spare USB port in easy reach of your screen. The documentation recommends not using a hub, but we ran it through a powered USB 3 hub with no apparent problems. Run the Spyder software, take in what it says about light falling on your screen and resetting the color temperature, plug in the colorimeter, then hit "Next" [Image C]. If multiple screens are detected, you're asked which monitor you want to calibrate (it only recognized one of ours, cataloguing the other as "Generic PnP"), then hit "Next" again. It's a wizard-based process, so is easy to follow.

4 WHAT EXACTLY IS IT?

If your monitor hasn't been recognised correctly, you need to feed this into the software. First, tell it whether you're calibrating a desktop or laptop, then paste the make and model into the next screen [Image D]. Hit "Next."

5 BALANCING ACT

This is the point at which you need to introduce the calibrator to your screen; the software tells you where to put it [Image E]. Make sure it's plugged in and the lens cap is removed. The lens cap slides on the cable, and can be used as a counterweight, so you hang the cable over the top of your screen, with the calibrator at the front, and the cap at the back. It's a nice idea, but the cap isn't nearly heavy enough, and the calibrator tends to swing around and lose contact with the screen. We tilted our screen backward, as it's on an arm mount, so it made better contact, but still had to hold the cable at the top of the screen to stop it moving. If you need to hold the colorimeter in place for the full calibration process, it not only gets boring, but makes your arm ache, too. Be sure to have your cell phone in easy reach, because you won't be using your computer. The calibration process takes around five minutes, while your screen cycles through black, white, and different colors of varying brightnesses.

F

6 FINISHED

When the process is finished, remove the calibrator, making sure to put the lens cap back on to protect it, and hit the "Finish" button on screen. You're prompted to save the calibration profile, which will be loaded into your video card every time you switch your PC on, and choose an interval at which you'll be reminded to recalibrate your screen. We've chosen to recalibrate ours in a month's time, because the change in color temperature of the ambient light as the year wears on can alter how you perceive your screen's colors. Monitors also change as they age, with subtle differences in the color output between opening the box and now.

7 BACK AND FORTH

The software now shows a series of images, and enables you to flip between calibrated and uncalibrated views [Image F], so you can see how much difference it's made. If you've got another screen, you can go on to calibrate it in an attempt to match its output to the calibrated monitor.

The Spyder app moves itself to the screen you choose from its drop-down menu, saving you the effort of using the mouse to drag it across. ■

Software calibration

Windows 10 has its own built-in screen calibration process, but instead of a calibration device, it uses the human eye.

The tool can be found in the Control Panel, in an applet called Calibrate Display Color, and it opens as a maximized gray window. It's another wizard, so hit "Next," and you're taken through gamma, brightness, and color adjustments, with sliders to make changes that remove unwanted color casts from the gray bars you're presented with. What you're doing is deciding what looks best to you, trying to get grays to look neutral, and contrast not to be too white or black-heavy. Once you've finished, you can launch ClearType tuning to maximize the clarity of type on your screens, too, which is another process carried out with your eyes, choosing which of the examples you're given looks clearest to you.

Share from iPhone or iPad

From files to photos, iOS makes it incredibly easy to share your stuff.

Carrie Marshall.

If sharing is caring, then iOS cares a lot. It has lots of ways to share your stuff with other people and your other devices. It all starts with the Share sheet, which pops up whenever you tap the Share icon, or the word Share on some devices.

The sheet is context-sensitive, which means the available options change depending on what app you're using, and it's full of useful tools. For example, in Safari it doesn't just enable you to share web pages, but also allows you to save a page as a PDF, or request the desktop version of a mobile site.

As you'll discover, you can share by email, messaging apps, wirelessly to another Apple device, and further afield using cloud storage services such as Dropbox.

In this tutorial we show you how to share files, photographs and web pages. If you want to share downloaded apps and purchases from the iTunes and App Stores, as well as shared storage and Apple Music subscriptions you can do that with Family Sharing.

how to

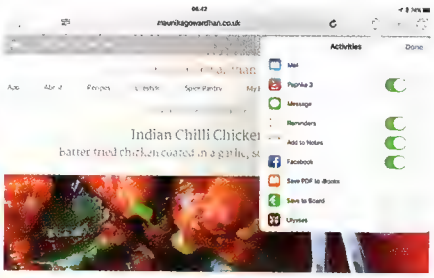
Share from (almost) any app

1 SHARE WHAT YOU SEE

You can share from any app that displays the Share icon, which is the box with a vertical arrow pointing upwards — it's on the far right of Safari's toolbar in the above screenshot. Tap it to see the share options available to you.

2 DECIDE WHAT TO DO

Swipe on the middle and bottom rows to see even more options. For example, we can share this recipe from Safari to Facebook, save it to iBooks, or post a link on Twitter. You'll also see the option to create a PDF.



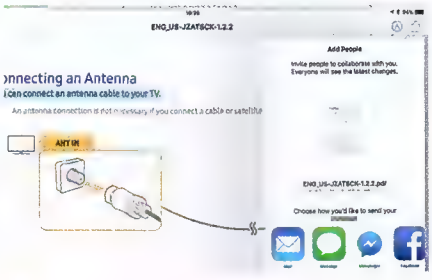
3 REARRANGE THE OPTIONS

Scroll to the far right of a row and tap More to show or hide items, and to reorder them so the most used are listed first. If you don't send web pages to Reminders you might turn off that option, but bear in mind that affects other apps.

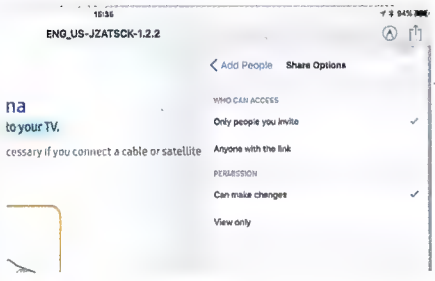
how to

Share with groups of people

1 FIND YOUR PEOPLE
You can use iCloud Drive to share files with multiple people. To do that, open the Files app, select a file — in this example we're using a PDF — and tap the Share icon. You should now see Add People among the options in the bottom row.



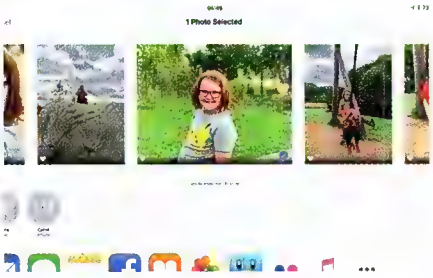
2 SELECT THE SERVICE
Now you need to choose how you want to send your sharing invitation. Mail and Messages are the most likely options, but you can also send it using third-party apps, such as Facebook's Messenger, if you have one installed.



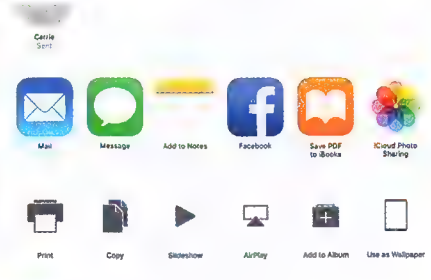
3 SET THE OPTIONS
Tap 'Share Options' to specify whether the link that's generated will work for anybody or just the specific people you've invited, and whether others can make changes to your document or if it should be read-only.

how to

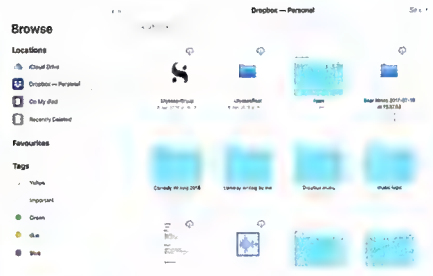
Share photos and folders



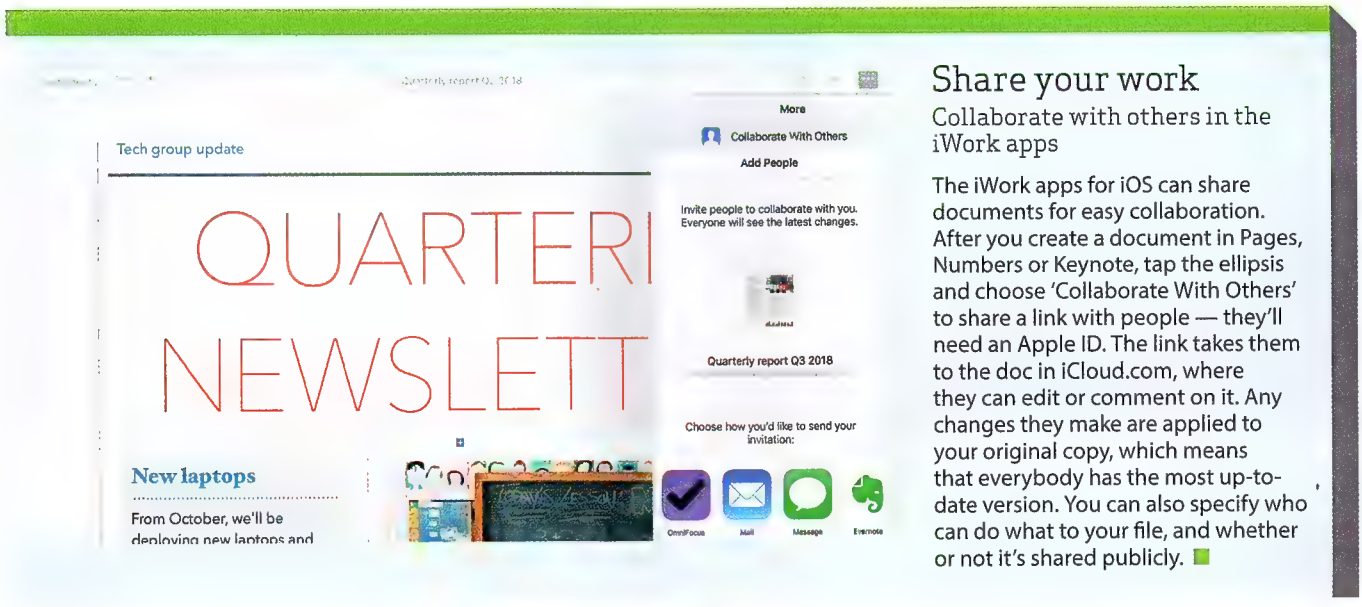
1 SELECT YOUR PHOTOS
In Photos, select some pictures, then open the Share sheet. The top row shows nearby Apple devices. If none are listed, check the recipient is set to receive from contacts or everyone (in Control Centre), and has Personal Hotspot turned off.



2 SEND THE PHOTOS
To share using AirDrop, tap the device's icon in the top row. Here we've shared with our iMac. A blue progress line goes around the icon while sending, then changes to 'Sent' as confirmation. Other people have to accept receipt.



3 USE EXTERNAL APPS
iCloud can share individual files, but it can't do it for whole folders. If you want to do that you'll need to install the app for a third-party service such as Dropbox, which integrates with iOS's Files app for easy access from the sidebar.



Share your work

Collaborate with others in the iWork apps

The iWork apps for iOS can share documents for easy collaboration. After you create a document in Pages, Numbers or Keynote, tap the ellipsis and choose 'Collaborate With Others' to share a link with people — they'll need an Apple ID. The link takes them to the doc in iCloud.com, where they can edit or comment on it. Any changes they make are applied to your original copy, which means that everybody has the most up-to-date version. You can also specify who can do what to your file, and whether or not it's shared publicly.

Customise your Mac workspace

Kenny Hemphill explains how to personalise your Mac to suit your workflow.

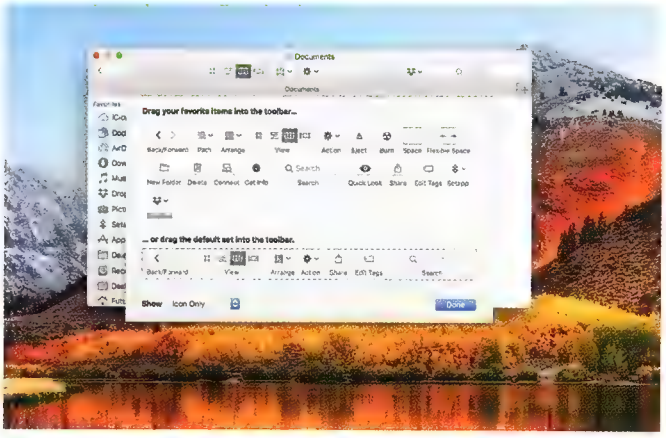
Mac users fall into two groups. There are those who set up their desktop and workspace exactly the way they want it to make them as productive as possible. The rest of us leave almost everything as it is and promise ourselves that one day we'll get round to setting it up properly.

This tutorial is aimed squarely at the second group, which we'd wager easily makes up the bulk of Mac users. The good news is that there are lots of ways you can configure your Mac so it's easier to navigate, simpler to access the files, folders and tools you need, and make you much more productive.

We've described tips here that can be carried out without any additional software or knowledge. However, if you want to go further, there are lots of apps that will allow you to perform further customisation and even automate processes so that if, for example, you leave files lying across the desktop, they are filed away neatly without any intervention from you.

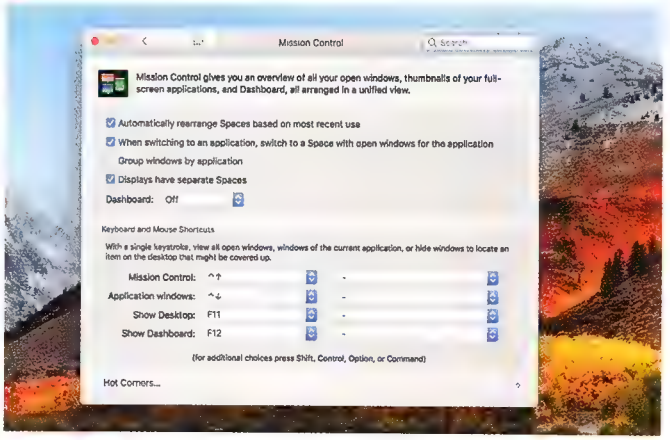
how to

Organise your apps



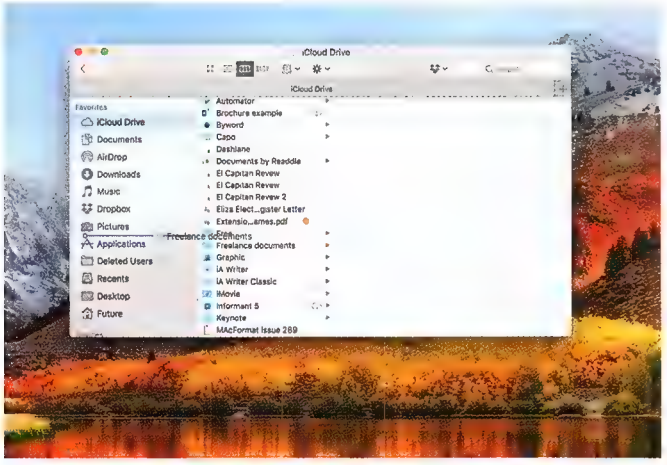
1 FINDER'S TOOLBAR

Click Finder's icon in the Dock, then choose View > 'Customize Toolbar'. From the pane that opens, drag an item onto Finder's toolbar. Repeat for other items. Choose a presentation style from the Show pop-up, then click Done.


Mission Control
Mission Control gives you an overview of all your open windows, thumbnails of your full-screen applications, and Dashboard, all arranged in a unified view.
Automatically rearrange Spaces based on most recent use
When switching to an application, switch to a Space with open windows for the application
Group windows by application
Displays have separate Spaces
Dashboard: Off
Keyboard and Mouse Shortcuts
With a single keystroke, view all open windows, windows of the current application, or hide windows to locate an item on the desktop that might be covered up.
Mission Control: ^↑
Application windows: ^↓
Show Desktop: F11
Show Dashboard: F12
(For additional choices press Shift, Control, Option, or Command)
Hot Corners...

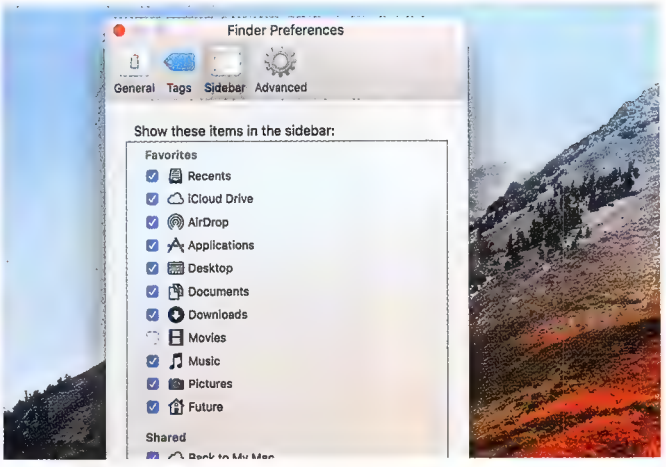
2 SET UP MISSION CONTROL

Go to > System Preferences and click the Mission Control icon in the top row of the window that opens. If you want to arrange desktops and full-screen apps manually, clear the 'Automatically rearrange Spaces…' option.



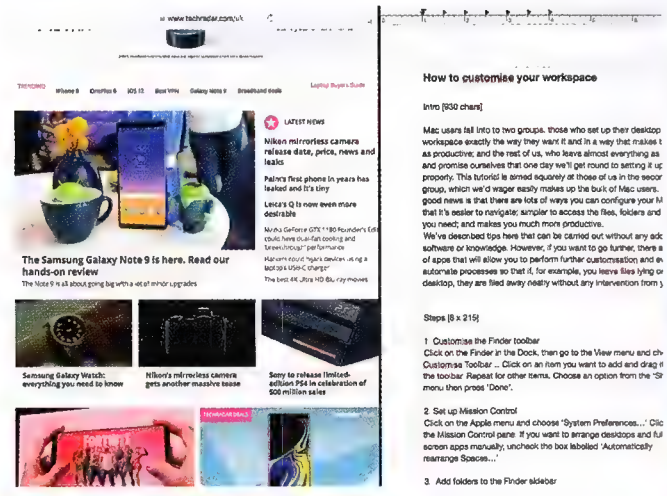
3 ADD SIDEBAR FOLDERS

Folders, even if they're stored on a remote server, can be added to the sidebar in Finder. Just drag the folder from a Finder window into Favorites in the sidebar. To delete a shortcut, Control-click on it and pick 'Remove from sidebar'.



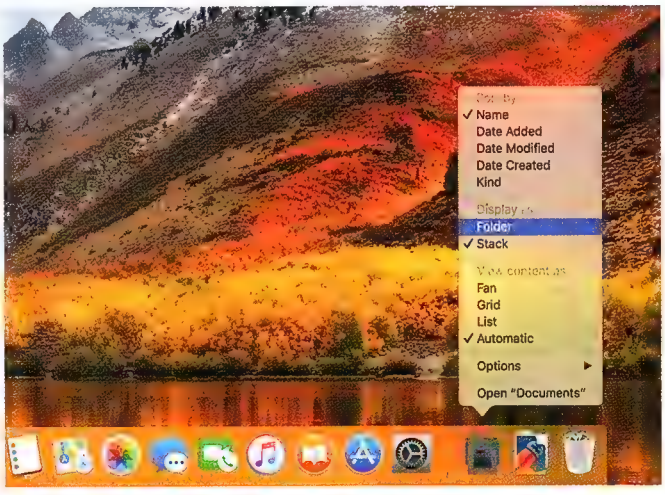
4 REMOVE SIDEBAR DEFAULTS

Switch to Finder and choose Finder > Preferences. Click on the Sidebar tab and then uncheck the items you don't want to see in the sidebar in Finder's windows. Don't forget to review Shared items, Devices and Tags below.



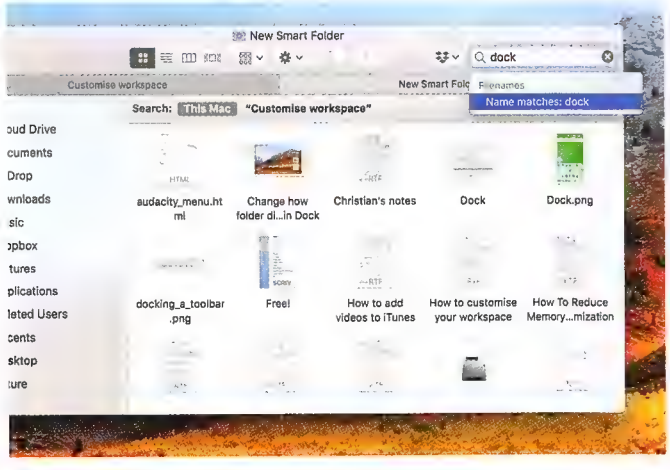
5 USE SPLIT VIEW

You can view two windows side by side by clicking and holding on the green full-screen button on one, then, when it shrinks, dragging it to the left or right. On the other side of the screen, click a window to make it fill that half.



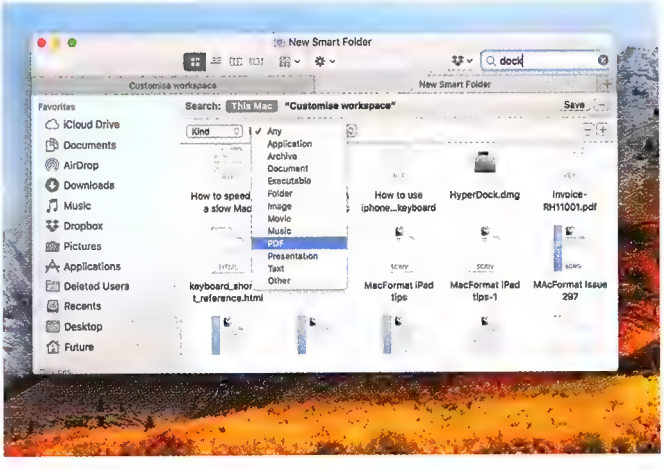
6 CHANGE A FOLDER IN THE DOCK

Add any folder to the Dock by dragging it to the area right of the line. Control-click it and pick 'Display as Folder' or 'Display as Stack' to set its icon style. The 'View content as' options set the display style for when the folder is opened.



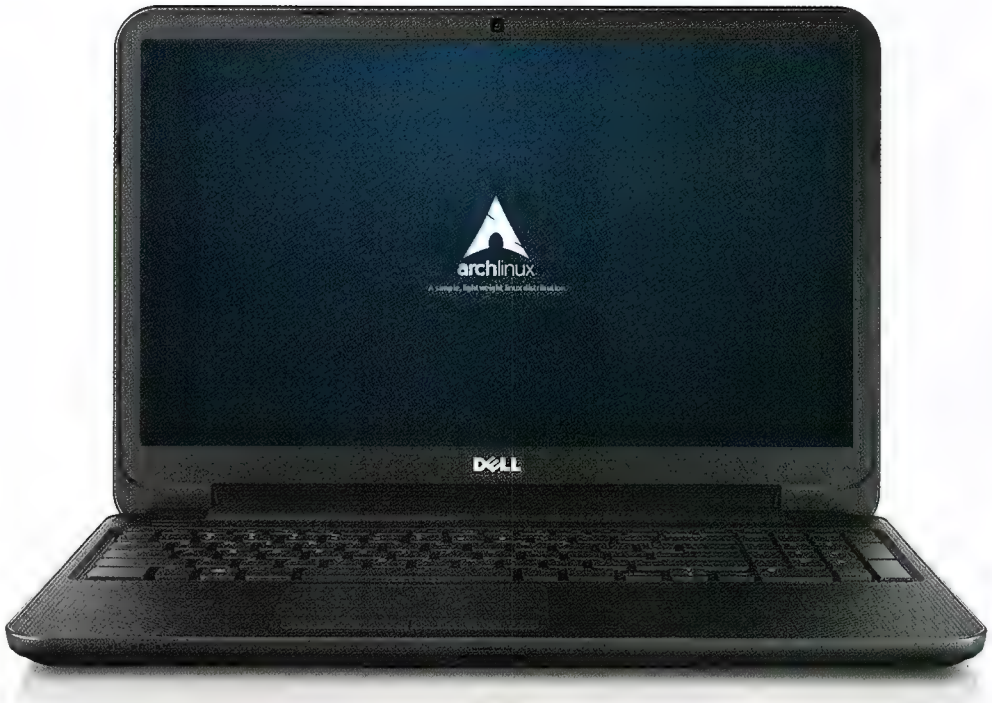
7 SET UP A SMART FOLDER

In Finder, choose File > 'New Smart Folder'. The contents of Smart Folders are dynamic. In the search bar, type your search term and choose whether matches should have it in their name or another suggested attribute.



8 ADD MORE OPTIONS

Click the + under the search bar to add criteria. Set each one's condition using the menus in its row. When done, click Save, then choose where to save the Smart Folder and whether to show it in Finder's sidebar.



Disk partitioning and Linux installations with cfdisk

Learn how to use cfdisk to partition disks, and how to install Linux on those new partitions, with John Gowers.

Any file storage system, whether it's a CD-ROM, a hard drive or a USB stick, is essentially a device for storing a long chain of 1s and 0s. When we interact with it, however, we don't see this; instead, we see files, directories, symbolic links and so on. The software that makes the translation for us is called a file system.

There's one step in between, though, and it's often overlooked. A particular file system need not take up the whole of the disk it lives on. Instead, the disk may be split up into individual sections, called partitions, each of which can have its own file system – or none at all. The disk keeps track of its partitions through its partition table, which tells it how many partitions there are, and where each one begins and ends.

There are a number of disk partitioning tools, but the one we shall be focusing on is one of the easiest to use, fdisk. In fact, we shall mainly be using its fancier cousin, cfdisk, which makes things easier still through its ncurses interface.

We'll be demonstrating some of the power of partitioning by installing a complete Linux system to a USB stick, while saving some space 'on the side' for file storage. The stick needs to be at least 8GB in capacity – and obviously, first make sure there's no data on it you want to keep, because we'll be removing everything.

Before partitioning your USB stick, you should find out what your computer identifies it as. Insert the stick into your computer's port (if it's already in, eject it and put it in again). Once it's in, run `dmesg` in a terminal and look for output near the end similar to the following:

```
  scsi host4: usb-storage
2-2:1.0
  scsi 4:0:0:0: Direct-Access
Generic Flash
Disk
  sd 4:0:0:0: [sdb] 512-byte
logical blocks
  sd 4:0:0:0: [sdb] Write
Protect is off
```

The thing we're looking for is the name sdb. Depending on your setup, you might see something different, such as sdX or hdp – but normally on a Linux system, it'll be sd followed by a single letter.

Let's suppose that your USB stick is available at sdb. You can verify this by running the lsblk command, which gives an overview of the storage on your system. You might see something like the output in Figure 1. Here, sda is our computer's hard disk, which is already split into partitions sda1 and sda2 (there may be more on your system). Meanwhile, our USB stick, sdb, has a single partition, sdb1.

USE PARTITIONING

Once you've identified the device name for your USB stick, you can fire up cfdisk:

```
# cfdisk /dev/sdb
```

If your USB stick is not at sdb, use the other value here instead. You should see a screen like the one in

the main image below.

Using the arrow keys, you can navigate between the partitions currently on the stick. Each row of the table represents a contiguous range of memory addresses that is either a partition or an area of empty space. Most likely, you'll start off with a single partition and empty space, as in Figure 1. Use the left/right arrow keys to select the [Delete] option and press Enter to delete this partition. If there are any other partitions, use up/down to select them and then delete them as well, so that the entire USB stick is free space.

Let's start partitioning the drive. Our first partition will be 2GB in size. Use the left/right keys to select the [New] option at the bottom and press Enter. At the prompt, enter `2G`, and press Enter again to create the partition.

This should have been fairly easy, so let's make a new partition. Press the down arrow to move the cursor at the top into the Free space row: we will create the next partition in here. Select [New] as before, and this time type in `250M` rather than 2G, before pressing Enter to create a new partition of size 250MB.

This partition is going to play a special role: it's going to be the boot partition for our USB stick. Any bootable medium, whether it's a Live CD, your laptop's internal hard drive or a live USB stick, has to have a special partition called the boot partition that contains various files necessary for booting up the system. The boot partition may contain other files as well – indeed, various older systems are entirely contained inside one bootable partition – but it is a bit more robust to only use the boot partition for booting purposes.

For now, all we need to do is to make this partition bootable. Keeping the cursor at the top focused on your new partition (which might be named /dev/sdb2), use the left/right arrows to select the [Bootable] option, and press Enter to set the bootable flag. You should see a small star (*) appear next to /dev/sdb2 at the top, in the Boot column.

Now let's create another 2GB partition after the one we've just made. Press the down key to move into the Free space, and then select

Alternatives to cfdisk

There are many different disk partitioning tools. You might want to give cfdisk's predecessor, fdisk, a try: you'll have to type commands, such as d for delete, rather than selecting buttons on an interface. A more powerful, but slightly more difficult tool is parted; if you want to use this, you might consider installing GParted, which gives you a full-blown graphical interface.

1

```
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda      8:0    0  140.0G  0 disk
|—sda1   8:2    0  260M    0 part /boot
|__sda2  8:8    0  139.5G  0 part /
sdb      8:16   1  7.5G    0 disk
|__sdb   8:17   1  7.5G    0 part
```

We can use the lsblk command for a useful high-level overview of the partitions on the devices on our system.

> "There are a number of disk partitioning tools, but the one we shall be focusing on is cfdisk."

```
                          Disk: /dev/sdb
        Size: 7.5 GiB, 8054112256 bytes, 15730688 sectors
Label: gpt, identifier: 83189F52-EBCC-4325-811C-AE03BEB92CF8

    Device          Start        End    Sectors  Size Type
>>  /dev/sdb1        2048   15730654   15728607  7.5G Linux filesystem

 Partition name: Linux filesystem
 Partition UUID: 634D2965-E930-4BB6-963A-29C362390E19
 Partition type: Linux filesystem (0FC63DAF-8483-4772-8E79-3D69D8477DE4)
Filesystem UUID: bf9b1e72-e921-4e9e-93a2-98c451bd631d
     Filesystem: ext4

[ Delete ]  [ Resize ]  [  Quit  ]  [  Type  ]  [  Help  ]  [ Write ]  [  Dump  ]

Write partition table to disk (this might destroy data)
```

cfdisk makes it easy to partition disks through its user-friendly interface. Admittedly, this might not look all that friendly with so many numbers floating around, but it's a lot easier than using the command line!

2

```
# mount --bind squashfs-root squashfs-root
# mount -t proc none squashfs-root/proc
# mount -t sysfs none squashfs-root/sys
# mount -o bind /dev squashfs-root/dev
# mount -o bind /dev/pts squashfs-root/dev/pts
# cp -L /etc/resolv.conf squashfs-root/etc
```

In order to chroot into the Linux system on disk, we need to connect the 'magic directories' to their counterparts on the base system.

"A nice feature of Linux is that we can run other Linux installations within the main one."

[New] at the bottom again, typing in `2G` and pressing Enter as before. At the top of the display, we might see something like the following:

```
    Device     Boot Start
End  Size
  > /dev/sdb1          2048
4196351    2G
    /dev/sdb2 *  4196352
4708351  250M
    /dev/sdb3    4708352
8902655    2G
    Free space   8902656
15730687  3.3G
```

Having the free space at the end means that we can come back and use the [Resize] option to grow the sdb3 partition if we want to later on. Growing the sdb1 and sdb2 partitions will be much harder once all the partitions have data written to them: we will need to recreate the partition table in full in cfdisk, and then use another tool (such as dd) to shift the data into the new positions. This is both time-consuming and potentially dangerous to the data if any errors occur.

The very last step is to write this partition table to the USB stick. At the moment, nothing we have done has actually altered the state of the disk at all, which is a very good thing: if you make any mistakes, you can correct them (or select [Quit] to start again completely) and be sure that you won't have messed anything up. This is particularly important if you are repartitioning a disk that already contains data, since writing the partition table incorrectly could destroy some of that data.

Using the left/right keys, select [Write] at the bottom, and press Enter. cfdisk will check one last time that this is what we actually want to do:

```
Are you sure you want to
write the partition table
to disk?
    Type "yes" or "no", or
press ESC to leave this
dialog.
```

Type `yes` and then press Enter to write the partition table. Lastly, navigate to [Quit] and press Enter to close cfdisk. We can check what we've done by running lsblk again. After these changes, the sdb portion of the output should look something like this:

```
sdb      8:16 1  7.5G 0 disk
|-sdb1   8:17 1  1.9G 0 part
|-sdb2   8:18 1  238M 0 part
|__sdb3 8:19 1  2G   0 part
```

At the moment, our partitions aren't doing anything. All we've really done is to alter something called the partition table, which tells the disk where each partition begins and ends. If we want to start using the partitions to store files, we need to format them as file systems and then 'mount' them to the operating system.

The standard file system for Linux is called Ext4, while boot partitions are often formatted using the FAT32 system (because FAT32 tends to be supported by a wide number of hardware devices and non-Linux-based operating systems). We can create these file systems using the mkfs.ext4 and mkfs.fat commands:

```
# mkfs.ext4 /dev/sdb1
# mkfs.fat -F32 /dev/sdb2
# mkfs.ext4 /dev/sdb3
```

You'll need to wait a few seconds, but soon the file system will be present. You might want to try mounting one of these partitions – that is, make it available to be used by the operating system – so that you can test out the file system. You can do this using the mount command, like so:

```
# mount /dev/sdb1 /mnt
$ cd /mnt
```

Now our partition sdb1 is mounted as the /mnt directory, and we can explore it, add new files and so on:

```
# touch a.file
$ ls
a.file  lost+found
```

Don't go overboard adding files, though, since we will be overwriting all the data in this partition. Once you've finished, navigate out of the /mnt directory and unmount the partition using umount. There are a couple of ways to do this – use

```
# umount /dev/sdb1
```

or, if you prefer:

```
# umount /mnt
```

The results are exactly the same.

INSTALLING LINUX TO A PARTITION

We'll demonstrate some of the power of partitioning by installing a very basic Arch Linux distribution to the sdb1 partition. Arch Linux is a good choice for this, since it can easily be installed from the command line. First, you need to download the Arch ISO image, which you can find at **https://www.archlinux.org/download**. Move this file into a new empty directory where you can do some work. For example:

```
$ mkdir arch
$ cp ~/Downloads/
archlinux-2018.08.01-x86_64.
iso arch
$ cd arch
```

Inside this directory, create a directory called arch. We'll mount the ISO image to this directory using the fuseiso tool like so:

```
$ fuseiso archlinux-
2018.08.01-x86_64.iso arch
```

The ISO image is now mounted in the arch directory. It essentially contains a minimal Arch Linux distribution. A nice feature of Linux is that it enables us to run other copies of Linux within the main copy, without having to boot up from an installation medium, and the next few steps will show how we do this. It is worth mentioning, however, that it might be easier to burn the ISO image to a disc and

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boot from that, before skipping to the installation instructions in the next section.

Once we have the ISO image mounted at arch, we can copy out the file we need, airootfs.sfs, before unmounting the ISO:

```
$ cp arch/arch/x86_64/
airootfs.sfs .
$ fusermount -u arch
```

The airootfs.sfs file is compressed using the SquashFS file system. The first step is to unsquash (aka decompress) it:

```
# unsquashfs airootfs.sfs
```

This creates a new directory, squashfs-root, containing the bare-bones Arch Linux system. The next step is to connect the 'magic' file systems /dev, /sys and /proc to their counterparts on our main system. These directories don't contain files in the traditional sense; they're meant to be linked to hardware objects and system resources.

For example, on our main system, /dev/sdb is the location of our USB stick. If we want to be able to refer to this device as /dev/sdb on our new system, we'll need to connect /dev on the main system to /dev on the new one. We do all this using the mount command, as in Figure 2. Lastly, we can use the chroot command to log on to the Arch installation that is living inside the squashfs-root directory:

```
# chroot squashfs-root
bash
```

We find ourselves dropped at a terminal: to all intents and purposes, we are now running on the new system.

INSTALLING LINUX TO THE USB STICK

By this point, you should be logged into a bare-bones Arch Linux system – either if you've followed the instructions above, or if you've booted off the ISO image directly. At the moment, there is next to no software installed on this system, so you need to use Arch's pacman package manager to install some basic programs:

```
# pacman-key --init
# pacman-key --populate
archlinux
# pacman -Syyu
# pacman -S base base-
devel
```

Some of the commands might produce a bit of output; make sure you run them all, though.

One problem we need to fix is that the partition table is currently in MBR mode, whereas most bootloaders require a GPT partition table. MBR is a much older format, and is less capable than GPT. To make the switch, use the sgdisk command, which should already be installed on the Arch system (if not, run `pacman -S gptfdisk`):

```
# sgdisk -g /dev/sdb
```

We now need to mount the partitions we created earlier inside the new system, which we do using the mount command as before. You can mount the root directory / to the main partition and the /boot directory to your boot partition, like this:

```
# mount /dev/sdb1 /mnt
# mount /dev/sdb2 /mnt/boot
```

You should now be able to run the following commands to install Arch Linux on the USB stick.

```
# mkdir -p /run/shm
# pacstrap /mnt base
```

This step should take a bit of time. When it has finished, Arch Linux should be installed on the USB stick. We still need to install some additional software on our new installation in order to make it bootable. First, do another chroot to take you to the new installation of Arch that you created on the USB stick:

```
# genfstab -U /mnt >> /mnt/
etc/fstab
# arch-chroot /mnt
```

You should be dropped at a new terminal, and are now effectively running Linux off the USB stick. Sometimes there's a problem with the installation of the linux package by pacstrap, so run `pacman -S linux` to reinstall it. Now we can install the bootloader using the following command:

```
# bootctl --path=/boot
install
```

The last step is to create an boot entry for the new installation, which we do by writing appropriate contents to a new file, /boot/loader/entries/arch.conf, as in Figure 3.

The installation should now be set up on the USB stick. Press Ctrl-D to leave this chroot environment, and then run `umount /mnt/boot /mnt` to close down the mount points. Then press Ctrl-D to leave the original chroot environment, and run sudo umount -l squashfs squashfs/* to remove the mount points we created earlier. Lastly, shut down your computer and boot it up from the USB stick. You should be in a basic version of Arch Linux.

It's up to you to create more partitions and install more Linux systems to the USB stick if you want to take things further. You should use a different partition for each installation, though you should use the same boot partition for all of them.

Installing Linux through a graphical tool

Many Linux distributions – for example, Antergos and the various flavours of Ubuntu – provide you with a graphical tool for installing Linux to new media.

For this, we recommend booting from a Live CD and then running the tool. At some point, you should have the option to choose the partitions to which to install Linux. For Antergos, for example, you can select 'Choose exactly where Antergos will be installed', and you then have the option to choose the correct main and boot partitions. It's always useful to know how to do this manually, though.

3

```
# cat > /boot/loader/entries/arch.conf
Name Arch Linux
linux /vmlinuz-linux
initrd /initramfs-linux.img
options root=/dev/sdb1 rw
<Ctrl-D>
```

If you want to install multiple Linux distributions to the same medium, you should create a configuration file like this for each of them.

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Protect your identity with the VPiN

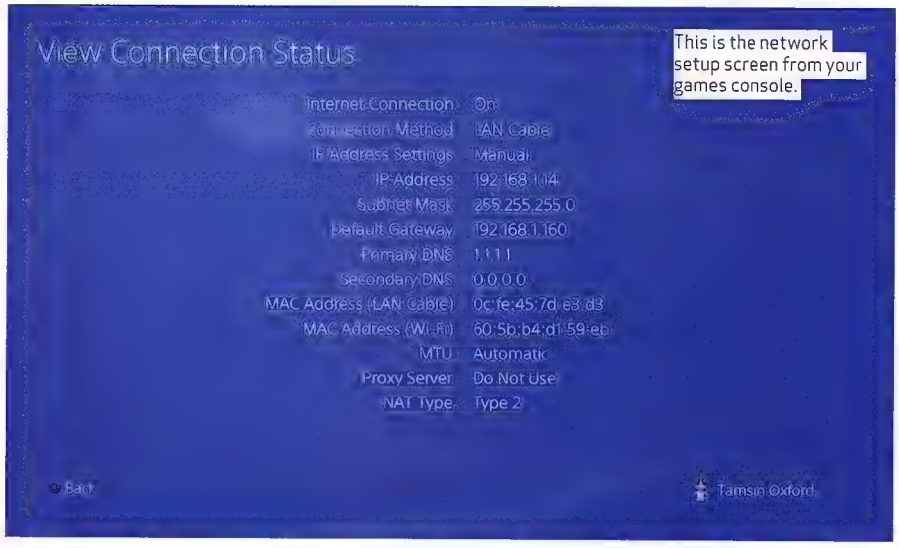
Adam Oxford turns an old Raspberry Pi into a VPN gateway for your home.

Caring about your online privacy and actually following best practices to protect it are two different things. As *APC* readers, it's likely that you know the principles of what we should do to avoid the great data collectors and geo-locators in the sky, but maintaining constant vigilance is an effort that soon gets tiresome, if not downright impossible.

For example, you know that you should be using a VPN to avoid ISP-level filters imposed by various pieces of the law. Setting up and using a log-free VPN service from your PC's desktop is straightforward enough, but what about all the other devices in your home? For example, if you use a games console to watch Stan, Netflix or YouTube on your TV, how do you route traffic from there effectively? No consoles have built-in VPN software. There's no app in the PlayStation Store.

One solution would be to buy a router that can connect directly to a VPN service, protecting all the traffic on your home network in a single stroke. Or, if you have an older router, to modify it with an OpenWRT firmware and add controls such as these in.

Or, if you want a cheaper and more straightforward solution, you could use a Raspberry Pi...



PI RIGHT THERE

With just a few fairly simple scripts, you can configure any Raspberry Pi to be a headless VPN gateway. This means that when it's connected to your router, you can send traffic to it from other devices before they connect to the outside world – essentially putting them behind a VPN. Here, we're using a first generation Pi – it's a nifty repurposing of a piece of kit that's past its sell-by date for most other common Pi-related projects.

To get started, you'll need four things. A Raspberry Pi, an SD card preloaded with the Raspbian operating system and a subscription to a VPN service of your choice. We're going to use NordVPN, which assures us that it doesn't log user behaviour or filter for particular activities such as P2P protocols. There are services that promise even more anonymity, or are more affordable, but Nord is a good place to start investigating options.

The fourth thing you'll need is a copy of your provider's OpenVPN configuration files and encryption certificates. There are usually a lot of these – one for each server you can connect to – so pick a handful that you want to be able to quickly access. We opted for two US servers, choosing one that supports the UDP protocol and one that supports TCP/IP.

You should find these configuration files on your VPN provider's website. Download them and unzip them into a folder on your desktop.

INSTALL PACKAGES

We want our Pi to be running headless, in other words without a keyboard and monitor attached, which means that once its up and running we'll need to access it using a remote shell and SSH. For the first run it can be easier to access the Pi directly by plugging in peripherals, at least until you have made sure it has a fixed IP address on your network, which is essential for this walkthough.

To do that, open a terminal on the Pi desktop and type `sudo nano /etc/network/interfaces` . Edit this file to look like this (you can choose any free IP address for the line that ends in 12, bear in mind that the 1 in the third part of the address could be another number).

```
auto lo
iface lo inet loopback

auto eth0
allow-hotplug eth0
iface eth0 inet static
    address 192.168.1.12
    netmask 255.255.255.0
    gateway 192.168.1.1
    dns-nameservers 1.1.1.1
1.0.0.1
```

Press Ctrl-O to write out the file, and then press Ctrl-X to quit nano.

Now turn the Pi off, and remove all peripherals leaving just the networking cable in place. Then reconnect the power supply to get it started again.

Once the Pi has booted up, you should be able to access it from another PC using SSH. In our case the command to connect is `ssh pi@192.168.1.12` and the password is the default, 'raspberry'. You'll probably want to change the password.

The next thing you'll need to do is install the OpenVPN packages with the following command:

```
sudo install openvpn
```

Next, navigate to the folder where you need to keep your OpenVPN configuration files by typing `cd /etc/openvpn` . You need to download the configuration files from your VPN provider, in our case we can do this using wget – don't forget to use sudo because the etc/ folder isn't writeable by ordinary users. In our case, the

One big edit for man

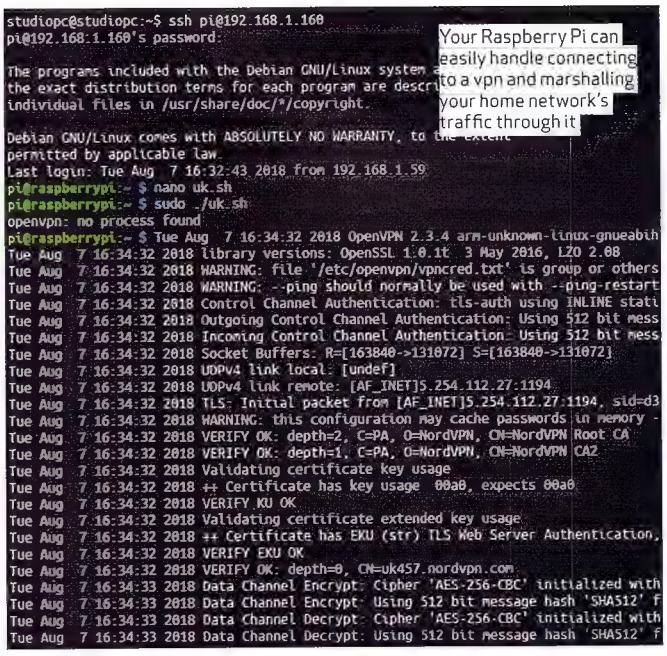
Remember that line in the VPN configuration file for `auth-user-pass` ? We need to change that so that credentials file we just created is called automatically. This means you need to change that line to `auth-user-pass vpnlogin` .

You can do that manually for the three or four servers that you think you'll use the most, and then just set-up scripts to start those servers when you need them. But what if you want to pretend you're in Sweden for a day, or South Africa? Can you even remember what the VPN password was?

NordVPN supplies over two thousand different config files, one for each server with both TCP and UDP protocols. To edit all those files at once open up an SSH connection to your Pi and navigate to **etc/openvpn** again. Now run the following command to use SED for a batch edit of all the .ovpn files.

```
find . -type f -name \*.ovpn -exec sed
-i.bak 's|auth-user-pass|auth-user-pass
vpnlogin|g' {} +
```

This will also create a backup of the existing files.


studiopc@studiopc:~$ ssh pi@192.168.1.160
pi@192.168.1.160's password:
The programs included with the Debian GNU/Linux system
the exact distribution terms for each program are descri
individual files in /usr/share/doc/*/copyright.
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to
permitted by applicable law.
Last login: Tue Aug 7 16:32:43 2018 from 192.168.1.59
pi@raspberrypi:~ $ nano uk.sh
pi@raspberrypi:~ $ sudo ./uk.sh
openvpn: no process found
pi@raspberrypi:~ $ Tue Aug 7 16:34:32 2018 OpenVPN 2.3.4 arm-unknown-linux-gnueabih
Tue Aug 7 16:34:32 2018 library versions: OpenSSL 1.0.1t 3 May 2016, LZO 2.08
Tue Aug 7 16:34:32 2018 WARNING: file '/etc/openvpn/vpncred.txt' is group or others
Tue Aug 7 16:34:32 2018 WARNING: --ping should normally be used with --ping-restart
Tue Aug 7 16:34:32 2018 Control Channel Authentication: tls-auth using INLINE stati
Tue Aug 7 16:34:32 2018 Outgoing Control Channel Authentication: Using 512 bit mess
Tue Aug 7 16:34:32 2018 Incoming Control Channel Authentication: Using 512 bit mess
Tue Aug 7 16:34:32 2018 Socket Buffers: R=[163840->131072] S=[163840->131072]
Tue Aug 7 16:34:32 2018 UDPv4 link local: [undef]
Tue Aug 7 16:34:32 2018 UDPv4 link remote: [AF_INET]5.254.112.27:1194
Tue Aug 7 16:34:32 2018 TLS: Initial packet from [AF_INET]5.254.112.27:1194, sid=d3
Tue Aug 7 16:34:32 2018 WARNING: this configuration may cache passwords in memory -
Tue Aug 7 16:34:32 2018 VERIFY OK: depth=2, C=PA, O=NordVPN, CN=NordVPN Root CA
Tue Aug 7 16:34:32 2018 VERIFY OK: depth=1, C=PA, O=NordVPN, CN=NordVPN CA2
Tue Aug 7 16:34:32 2018 Validating certificate key usage
Tue Aug 7 16:34:32 2018 ++ Certificate has key usage 00a0, expects 00a0
Tue Aug 7 16:34:32 2018 VERIFY KU OK
Tue Aug 7 16:34:32 2018 Validating certificate extended key usage
Tue Aug 7 16:34:32 2018 ++ Certificate has EKU (str) TLS Web Server Authentication,
Tue Aug 7 16:34:32 2018 VERIFY EKU OK
Tue Aug 7 16:34:32 2018 VERIFY OK: depth=0, CN=uk457.nordvpn.com
Tue Aug 7 16:34:33 2018 Data Channel Encrypt: Cipher 'AES-256-CBC' initialized with
Tue Aug 7 16:34:33 2018 Data Channel Encrypt: Using 512 bit message hash 'SHA512' f
Tue Aug 7 16:34:33 2018 Data Channel Decrypt: Cipher 'AES-256-CBC' initialized with
Tue Aug 7 16:34:33 2018 Data Channel Decrypt: Using 512 bit message hash 'SHA512' F

Your Raspberry Pi can easily handle connecting to a vpn and marshalling your home network's traffic through it

> "Now you can make your PS4 appear in another country without ever leaving the comfort of your lounge."

command is `sudo wget https://downloads.nordcdn.com/configs/archives/servers/ovpn.zip` , followed by `sudo unzip ovpn.zip` to decompress it.

A quick `ls` command will show if you have been successful. There should be a list of files ending in .ovpn. Note that some VPN providers may have packaged these files with subdirectories, as an example for connections encrypted with optional 128- or 256-bit protection. You'll need to move the files to the etc/openvpn directory using the `mv` command.

You can now open a connection to any of these servers using the command `sudo openvpn example.ovpn -daemon` , where `example` is the filename of the configuration file.

If you try this now, you'll notice that the script asks for your username and password to authenticate the connection. Do test to see if the connection is working by typing `ifconfig` . You should see a connection marked TUN, which is your VPN tunnel.

YOU SHALL NOT PASSWORD!

So far we have a slightly cumbersome way of connecting our Pi to a VPN via a terminal that requires you to enter your username and password when you want to connect. Good, but it could be better – we're going to create a few scripts to automatically create your credentials to save you some time.

Take a look at the VPN files you downloaded to your desktop and open one of them. You should see that it starts the client and that there's a list of commands. These include a line that contains `auth-user-pass` . We can alter this line to automatically feed a username and password to our config file when it is called.

Back in your SSH connection to the Pi, navigate back to /etc/openvpn and type `sudo nano vpnlogin` . This should open up the nano text editor. Create a text document that has nothing except your username for the VPN provider on the first line, and your password on the second. Hit Ctrl-O to write the contents to disk, then Ctrl-X to quit nano.

Once you've done that, pick the VPN connection you think you'll use the most and edit the config file using `sudo nano example.ovpn` . Change the line that says `auth-user-pass` to `auth-user-pass vpnlogin` .

Now when you start that connection using the `openvpn` command, it should connect directly without the password prompt. (See the boxout above for a way to change all the config files at once.)

So far so good, but we don't want to have to type a long command every time we need to connect to a VPN. Remember that you took a note of your most likely used servers right back at the start? Good, because we're going to create a quick script that will enable you to start and switch between those with a simple command.

It begins with an instruction to close any open VPN connections, then starts the OpenVPN daemon filling in the credentials from the text file we just created.

Back in your home folder, type `nano vpn1.sh` :

```
#!/bin/bash
sudo killall openvpn
sudo -b openvpn /etc/
openvpn/example.ovpn
```

Repeat this step for the three or four VPN connections that you think you'll use the most, adding one to the number in the filename. Now you can start or switch your connection by SSHing into the Pi from any computer on the network and typing `sudo ./vpn1.sh` .

Finally, to route traffic via the Pi, you'll need to go back to your PlayStation (or other device) and change the internet settings. Leave everything in its default setting apart from the Gateway and DNS servers.

Change Gateway to the IP address of your Pi, and set the DNS server to 1.1.1.1, 8.1.1.8.

And that's it. Now you can make your PS4 or other networked device appear in another country without leaving the comfort of your lounge.

What's the Go with Android?

Choosing your next Android device could be a tricky affair, regardless of whether you have a rocks or diamonds budget. Darren Yates explains why.

According to market analysts Gartner, worldwide sales of smartphones topped 1.5billion for the year in 2017 – more than 1.3billion of those were Android-powered (tinyurl.com/yay5cc2y). It's a staggering number, covering a broad array of devices from top-drawer phones to modest pre-paid cheapies. In fact, for every 512GB Samsung Galaxy Note 9 phone you can buy for $1,799, you can grab 26 of Alcatel's new $69 1C prepaid phones from discount stores and supermarkets. The spread of processing power in those devices is almost as diverse, which makes running the latest fully-loaded Android OS increasingly problematic. Phone makers have long solved this problem by simply loading up older, less-demanding versions of Android onto budget hardware, but that's led to a 'comet's tail' of aging Android devices, many of which no longer receive security or OS updates. However, there's now a growing set of Android options and programs for device makers to play with – each with consequences for you. Here's how these options stack up and what they may mean for your next Android device.

The Galaxy Note 9 is not an Android One device.

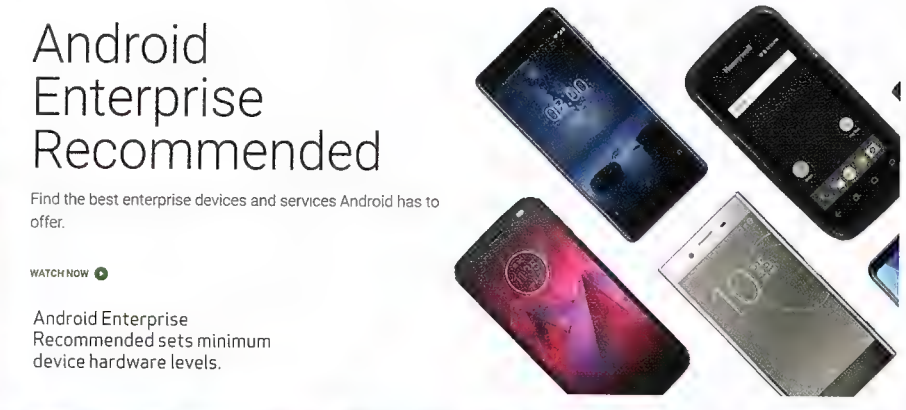
ANDROID GO EDITION

Android Go edition (**tinyurl.com/yc2gjpwy**) is the brand for Google's cut-down version of its latest operating system, which we expect to be dubbed 'Android 9 Pie (Go edition)' by the time you read this. It's come about because running the latest full-version Android OS on budget hardware is an increasingly difficult proposition – phone makers have to spend more to provide sufficient storage and, in particular, RAM to run the OS' fast-growing features list, affecting price-points. Added to that, the budget CPU chips inside many of these devices will likely struggle even more handling those growing OS demands without enough RAM.

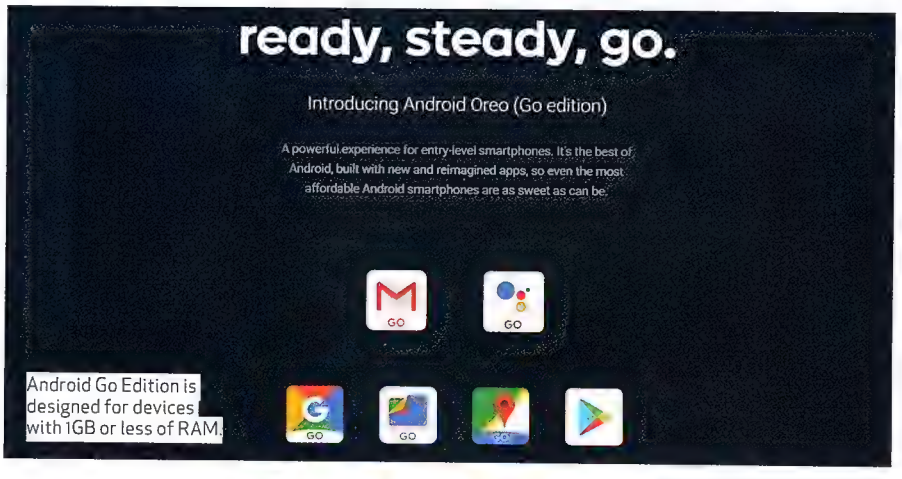
Now, budget phone makers have options and Alcatel's new 1-series shows this nicely. The new cheaper Alcatel 1C runs MediaTek's modest MTK6580 chip and Android 7.0/Nougat OS, yet manages to include 2GB of RAM. The MTK6580 is a quad-core chip based on ageing Cortex-A7 core tech that first popped up back in 2011, yet it's cheap enough to also allow the 2GB of RAM giving the OS room to stretch its legs.

Meanwhile, the slightly up-rated Alcatel 1X packs in the faster MTK6739 chip, the newer Android 8.1 Oreo (Go Edition) OS, but only 1GB of RAM. The MTK6739 has four considerably-faster Cortex-A53 cores, however, running the full Oreo OS with only 1GB of RAM would have been a stretch. So, Android Go Edition is designed for devices like this running 1GB of RAM or less.

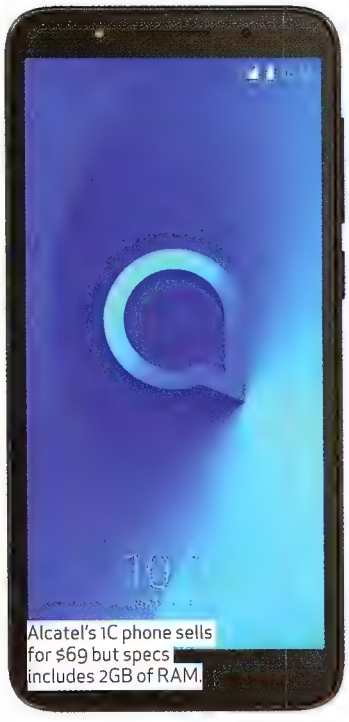
What gets stripped out to make a 'Go Edition'? For starters, with only 1GB of RAM to play on, Go's suite of Google Apps are said to be half the size as those in the full OS. The OS also receives a special 'Go' version of Google Assistant designed to run on low-RAM devices. You still get full access to Google Play, with no restriction on the apps you can install, other than those



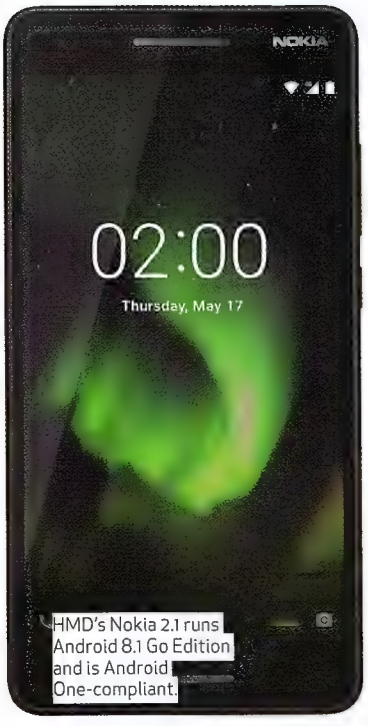
Android Enterprise Recommended sets minimum device hardware levels.


ready, steady, go.
Introducing Android Oreo (Go edition)
A powerful experience for entry-level smartphones. It's the best of Android, built with new and reimagined apps, so even the most affordable Android smartphones are as sweet as can be.
GO
GO
GO
GO
GO

Android Go Edition is designed for devices with 1GB or less of RAM.



Alcatel's 1C phone sells for $69 but specs includes 2GB of RAM.



HMD's Nokia 2.1 runs Android 8.1 Go Edition and is Android One-compliant.

The new Alcatel 1X phone runs Android Oreo 8.1 Go Edition OS

> "It needs to be at least IP64 ingress protection-certified and drop-test rated to MIL-STD-810G spec."

that are device or component-related. What's more, Google is encouraging app developers to reduce app size and optimise memory usage.

ANDROID ONE

If this all sounds a bit familiar, you're probably thinking of 'Android One'. This was a Google initiative announced a few years ago to bring a standardised budget Android platform to emerging countries. Today, Android Go Edition sort-of replaces that initial concept, with Android One now taking on a broader set of goals.

The Android One platform (**android.com/one**) now advertises 'AI-powered innovations' and 'security protections'. Drill down and there are specific additions locked in, such as monthly security updates for a minimum period of three years after the device's initial release (although the fine print says contact your device manufacturer for exact support duration). You're also guaranteed two years of Android OS updates.

However, Android One offers no prescribed minimum hardware levels and according to reports, the program is more a joint-partnership specific to each device between Google and the manufacturer, rather than a stone-carved playbook. Still, there are tighter rules regarding add-on software, which means Android One devices look more like a stock Android Open-Source Project (AOSP) release – sans unwanted bloatware.

NOT MUTUALLY-EXCLUSIVE

But while Android Go and Android One are not the same thing, they can co-exist. For example, the new Nokia 2.1 phone runs Android 8.1 Oreo (Go Edition) OS, but is also Android One-compliant. As a result, you cannot rely on the 'Android One' logo to ensure a phone includes a full-version OS, especially at the budget end of the market.

You also won't be able to tell the OS just by the phone model generation – for example, the Nokia 2.1 runs the Android 8.1 (Go Edition) OS, yet the Nokia 3.1, which is also Android One-compliant, only runs Oreo/8.0, albeit the full version. What's more, phone makers can still add their own software onto an Android Go Edition device. Throw in the fact that these two Nokia phones have sold for the same $199 price in recent times at major retailers and you can see how complicated your choices have become.

The other important factor is that although Google has said it plans to offer future 'Go edition' updates, Android Go Edition alone is not a guarantee you'll receive any – something to remember, for sure.

ANDROID ENTERPRISE RECOMMENDED

While Android Go and Android One are essentially 'consumer' in focus, Android Enterprise Recommended (**tinyurl.com/y8a5hfmu**) is clearly centred closer to the big end of town. This new program was introduced in February 2018 and has similar goals to Android One, but this time, includes minimum hardware targets split into two different device categories – 'rugged' and 'knowledge workers'.

To get the Enterprise Recommended tick, a rugged device has to have at least Android 7.0/Nougat OS, 2GB of RAM, 16GB of storage and a 1.1GHz 32-bit CPU (interestingly, there's no mention of CPU core count). It needs to be at least IP64 ingress protection-certified and drop-test rated to MIL-STD-810G spec, or four drops from a 1.2-metre height.

Knowledge worker devices need 32GB of storage, 1.4GHz clock speed with 64-bit CPU tech, at least eight-hours of active battery life and twin cameras (10MP on the rear). IP-certification and MIL-spec drop-testing requirements are removed.

More interestingly, rugged devices must receive security updates within 90 days for five years from launch date, plus one major OS update within 18 months of the OS release. Given these

The Nokia 3.1 is an Android One phone but runs the full Android 8.0 OS.

devices are designed to last, it's not surprising the OS support should be expected to as well. Knowledge worker devices must be available in unlocked form, with security updates within 90-days of release for three years (**tinyurl.com/ybpdsepn**).

In practice, devices fitting the knowledge worker recommendation include the usual top-drawer suspects – the Google Pixel 2 XL, Nokia 8, LG's V30 and Sony Xperia XZ1. Android's recommended 'rugged' devices list includes brands such as Zebra, Sonim and Honeywell. Reports are Panasonic is among additional brands working through the certification process at time of writing.

RAM MATTERS

It may go against the grain, but when looking for your next phone, we think RAM should matter to you as much as the CPU chip under the screen. Sure, it sounds a bit boring and geeky, but if you're a power user, whether it's gaming or just running your office on your phone, the amount of device RAM is increasingly determining what you can do. If you need further convincing,

Sonim's new XP8 is an Android Enterprise Recommended rugged phone.

gaming hit Fortnite, with its minimum 3GB RAM requirement that matches its total storage needs, should be proof enough. If that's not enough, the 2GB minimum in the Enterprise Recommended program should do it.

That leaves us questioning just how long the 1GB limit for an Android Go device can survive. As app demands continue to grow along side those of the full Android OS itself, you'd have to think Google has to either strip more away from the OS to have it work inside 1GB of RAM, or risk dwindling performance. Neither option is all that appealing.

MORE DEVICES UP-TO-DATE

A major goal of all this work is to move the Android ecosystem closer to the latest Android release. With more than half the market still running Marshmallow/6.0 or older as of mid-September 2018 (**tinyurl.com/ker3bcv**), the ability to shore up security issues in older Android OS versions is limited at best, potentially leaving millions of Android devices at risk of security flaws. And this is before you even get to hardware security risks like the recent Spectre/Meltdown problems affecting many devices with Intel or ARM Cortex-A series technology. Android Go Edition helps address these issues.

GO PAST GO?

The pre-paid market is huge in Australia – as of mid-2017, Optus reportedly had 3.7million prepaid customers alone (**tinyurl.com/y86ccrph**) and given budget phones are popular in this segment, it's an important issue. If your budget forces you to choose between an older, less-computationally demanding version of Android with 2GB of RAM and a cut-down modern release with updates but stuck to 1GB of RAM, it's not an easy choice to make. It also remains whether or not Android Go Edition becomes the de-facto standard for budget phones, forcing your hand.

Arguably the simplest option is to just give up coffee for a month, save your pennies and buy further up the Android food-chain. Android Go's trimmed-down Google Apps may be fine on 1GB of RAM, but it doesn't guarantee the rest of the Google Play store will be. Nevertheless, regardless of your budget, the growth in Android device and OS programs means there's more to think about in choosing your next device than ever before.

androidone

The Android One program guarantees Android security and OS updates.

Designed by Google. Smart, secure and simply amazing.

Android One brings the latest AI-powered innovations and security protections to the new Nokia 6.1, Nokia 7 Plus and Nokia 8 Sirocco.

An introduction to R – Part 2

It's one of the top-two machine-learning languages and easier to learn than you might think. Darren Yates continues our machine-learning masterclass with a deeper look at R.

Machine-learning is fast becoming the buzzphrase of the age. Few areas of endeavour have escaped its charms over recent years. It's the subset of artificial intelligence that mixes computer science, statistics and mathematics, promising to make sense of the mountains of data we generate every day. All the major software players have cloud-based machine-learning services on offer. But while it can all seem quite daunting, the top two machine-learning tools continue to be programming languages Python and R. We introduced you to R last month via Kaggle's Titanic competition. This month, we begin looking at how to code your own R scripts from scratch.

SETTING UP R ON YOUR PC

If you missed last month's issue, we're using a combination of the R programming language and the RStudio integrated development environment (IDE). Both are open-source and freely available for Windows, macOS and Linux. We're using the Windows versions here. To simplify installation, you need to install R first, then RStudio. Grab R from the CSIRO mirror at **cran.csiro.au** and download the free RStudio Desktop from **rstudio.com/products/rstudio/download**. When you've installed them, fire up RStudio.

GETTING STARTED

The R language may have been designed specifically as a statistical language, but in some ways, it's actually not too dissimilar to Python. R allows you to write code files or 'scripts' and its structure or 'syntax' has touches of Java and Python about it. An R script file has the suffix '.R', but in practice, it's just a standard text file. You can create it with Notepad if you like, but we'll use the RStudio code editor instead.

With RStudio open, you'll see the code editor panel on the left. To create a new R script at any time, from the main menu, select 'File > New File > R-Script' or press Ctrl-Shift-N.

Use the left-arrow assignment symbol to assign values to variables.

The if-else conditional statement allows you to branch your R code.

Functions are excellent for creating neat and reusable code.

CODING BASICS

Now R supports many of the coding basics you'll find in other programming languages. For example, you can assign values to variables, you can print, read from and write to files on your system storage, create reusable code-blocks called 'functions', execute if-else statements and for-loops. You can also import external libraries or 'packages' that contain functions to perform new tasks. You can even take advantage of your CPU's multiple cores and write code that runs in parallel.

Because it's designed to deal with lots of data, R also has extra tricks up its sleeve, such as special functions that allow you to process data much faster than standard for-loops.

Let's start off with variables. Like Python, you do not need to declare a data type when creating a variable – you just assign the value you want to it. For example:

```
runs <- 6996
innings <- 70
sport <- 'cricket'
```

The first two assign an integer (it could also be a decimal-point or 'real' number), the third a string of characters. The assignment symbol is created using the left-arrow (<) key

followed by the minus key (-). You can perform maths during assignment, such as:

```
average = runs/innings
print(paste("Batting average:", average, "runs per innings"))
```

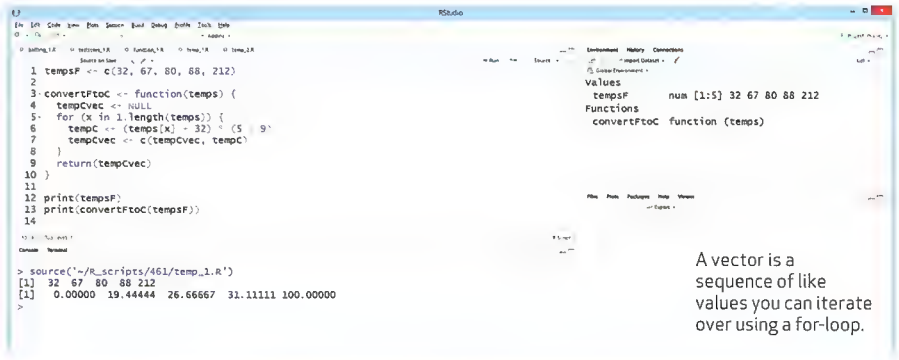
R's print command functions a little differently to Python – you can't use the addition (+) sign to concatenate or join variables. Instead, you use the paste() function with commas (,) separating variables and literals (a literal is a number or text string you want printed as it appears in the code). In the case above, we start by printing the text "Batting average:", followed by the value stored in the 'average' variable and finishing with the text "runs per innings". You can type these code lines yourself or you can load up the 'batting_1.r' script in this month's source code pack you'll find on our website at **apcmag.com/magstuff**. To run the code, select 'File > Open File' choose the file, then press the 'Source' button at the top-right of the code editor panel.

IF-ELSE

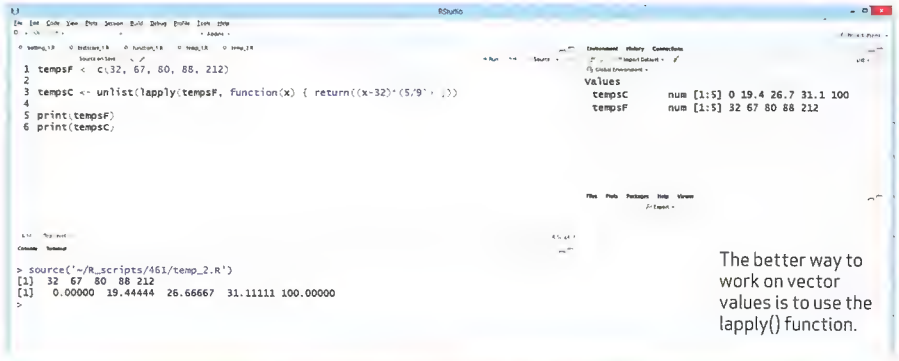
If you're familiar with IFTTT, the online conditional-action service (**ifttt.com**), then you already get the idea of conditional statements – if 'this' then 'that'. You can call it 'code branching' because the code execution changes or 'branches' depending on whether the condition (the 'this' bit) is true or false. Try this example:

```
testScore <- as.double(readline(prompt="Enter test score:"))
if (testScore >= 50) {
print("You passed!")
} else {
print("You need to do the course again.")
}
```

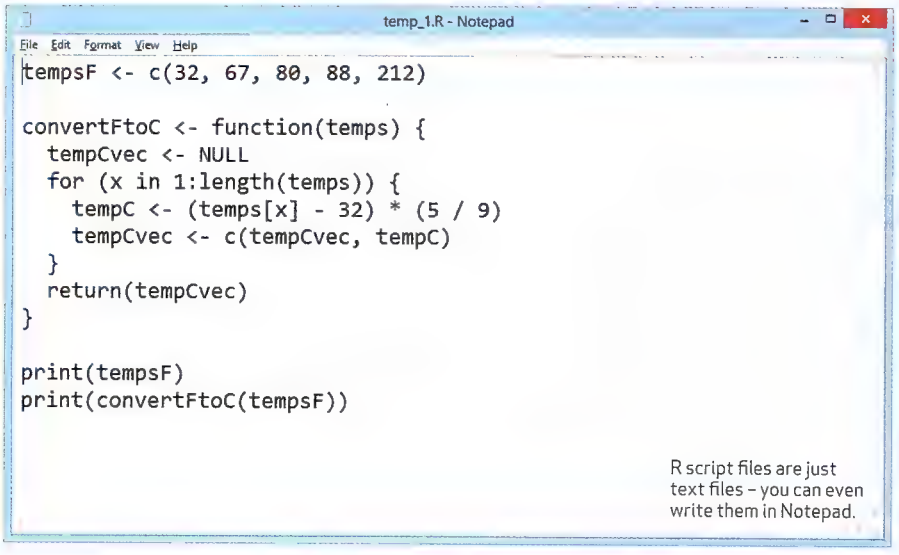
Here, we're using the readline() function to get input from the user. We also use the as.double() function to convert the characters into a decimal-point or 'double' value and store it in the variable 'testScore'. Next we introduce our if-else conditional statement. First, we check the value of testScore and if it's 50 or greater (>=), we print 'you passed', otherwise (else), we print 'you need to do the course again'. Note that each code block is separated by curly brackets {}. The key to operation here is if the conditional statement (testScore >= 50) is true, then the first code-block runs. If it's false, the code following the 'else' keyword, runs instead. So, if-then-else statement code-blocks are 'one or the other' type statements – you can't execute both.



A vector is a sequence of like values you can iterate over using a for-loop.



The better way to work on vector values is to use the lapply() function.



R script files are just text files – you can even write them in Notepad.

You'll find this in the source code pack as 'testscore_1.r'.

FUNCTIONS

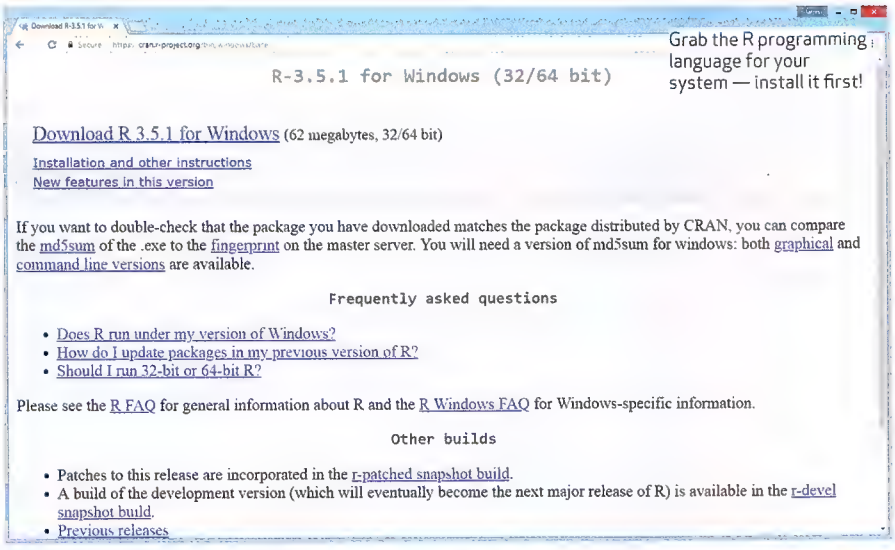
Like Python, almost every command in R is essentially a function and you can write your own custom functions to simplify your script structure. If you're coming from Python, the syntax is a little different, but not confusingly so:

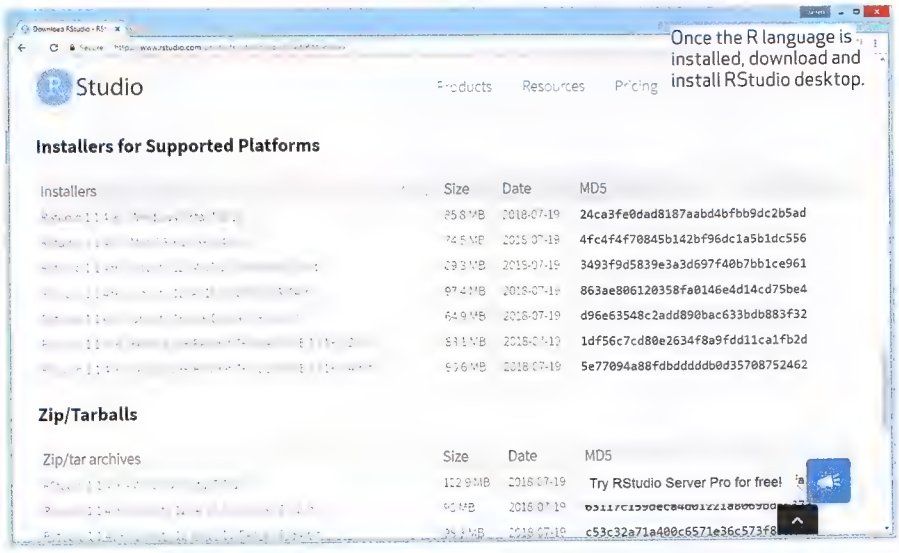
```
your_function <- function(parameter_1, parameter_2, …) {
… some function statements …
return(some_value)
}
```

This is the simplest form of function structure and starts with your function name, followed by the assignment symbol and the keyword 'function'. Following the keyword is a list of parameter variables that contain values you want to process in your function. Following this is a right-open curly bracket '{' signalling the start of your function code. Finally, the last thing you typically have is a return() statement, which returns the value from some variable that you can then do something else with. For example, we can turn our batting average example into a function like this:

```
calculateAverage <- function(runs, innings) {
average <- runs/innings
return(average)
}
```

You could also simplify it down to just:


Grab the R programming language for your system — install it first!
R-3.5.1 for Windows (32/64 bit)
Download R 3.5.1 for Windows (62 megabytes, 32/64 bit)
Installation and other instructions
New features in this version
If you want to double-check that the package you have downloaded matches the package distributed by CRAN, you can compare the md5sum of the .exe to the fingerprint on the master server. You will need a version of md5sum for windows: both graphical and command line versions are available.
Frequently asked questions
Does R run under my version of Windows?
How do I update packages in my previous version of R?
Should I run 32-bit or 64-bit R?
Please see the R FAQ for general information about R and the R Windows FAQ for Windows-specific information.
Other builds
Patches to this release are incorporated in the r-patched snapshot build.
A build of the development version (which will eventually become the next major release of R) is available in the r-devel snapshot build.
Previous releases




```
calculateAverage <-
function(runs, innings) {
  return(runs/innings)
  }
```

We can incorporate the function return straight back into the print statement:

```
print(paste("Batting
average:",
calculateAverage(6996,70),
"runs per innings"))
```

You'll find this version of the code in our source code pack as 'function_1.R'. Note that the parameters to calculateAverage() in the print() statement above are just literals – they could be variables as well, in which case, the values of the variables are passed to the function and everything continues as before. Our example is overkill for something this simple, but deliberately so, just so you can see the form and how it works.

VECTORS

So far, each of our variables has held just a single value. However, more useful in machine learning is a sequence of values. In Python, you might call this a 'list' and in Java, an 'arraylist'. In R, the most basic form of list is called a 'vector'. Vectors are easy to create – here's an example of five temperature readings in degrees F:

```
tempsF <- c(32, 67, 80, 88,
212)
```

The c() function allows us to combine values into a single vector and we store them in the vector 'tempsF'. Suppose we now want to convert these into a vector of degrees C. We could write a function 'convertFtoC' to look like this:

```
convertFtoC <-
function(temps) {
  tempCvec <- NULL
  for (x in 1:length(temps)) {
      tempC <- (temps[x]
- 32) * (5 / 9)
      tempCvec <- c(tempCvec,
tempC)
  }
  return(tempCvec)
  }
  print(convertFtoC(tempsF))
```

The original vector of values is 'tempsF', but these values are fed to the function, where they now become the internal 'temps' vector. We then use a for-loop to iterate over each element, convert it, store it in the temporary variable 'tempC' and add it to the tempCvec vector using the concatenating trick of tacking on each new tempC value to the end of the existing tempCvec vector and adding it back to itself. The source code for this is in the source code pack as 'temp_1.R'.

FORGET LOOPS

Yet while the code works, for-loops in R are usually quite slow. You won't notice it in this example, but you would have if the vector had 10 million temperatures to convert. However, we can do the same thing much faster without a for-loop using the lapply() function in the file 'temp_2.R':

```
tempsC <- lapply( tempsF,
function(x) {return( (x-
32)*(5/9) )} )
```

The lapply() function allows you to iterate over a vector or 'list', performing tasks on each element in that vector. The function also returns a list with the same length as the input vector. So starting on the right-side of the assignment, the input vector is the original 'tempsF' vector and following that we have an anonymous function, 'function(x)'. The 'x' is a temporary variable holding each value from vector tempsF in turn. We take each value, convert it to degreesC and return that value back to the new vector 'tempsC'. The lapply() function automatically calculates the input vector's element count so we don't have to. The result is a much cleaner and faster function.

GIVE IT A GO

If you've coded before, then at least some of this probably looks familiar. You might even be wondering when we're going to get to some real machine-learning. Like most things, there's little point rushing in before we're ready, so it's important to get a feel for R with the basics first. Next month, we crank things up a notch by looking at R's nuts and bolts for machine learning in matrices and dataframes, as well as how to use them with the apply() functions. In the meantime, have a play around with RStudio! ■

downtime

» STEPHEN LAMBRECHTS & SHAUN PRESCOTT KNOW WHAT'S IMPORTANT.

PS4 consoles bricked by malicious messages

THANKFULLY, AN UPDATE IS SAID TO FIX THE BUG.

Users on social media and Reddit have reported crashes and bricked PS4 consoles after receiving unsolicited coded messages. As reported by *The Verge*, the malicious messages include unreadable characters that will cause glitches on the PS4 when opened, leading some users to factory reset their consoles. Sony has released a firmware update which should put an end to the issue. SL

Cloud gaming gets real

GAME STREAMING GETS SERIOUS WITH NEW GOOGLE AND MICROSOFT INITIATIVES

Google and Microsoft both unveiled new game streaming technology in early October, in what might become yet another platform war to take sides in. Microsoft's xCloud technology, which will undergo public trials in 2019, can stream any Xbox game to any smart device with an internet connection. "Our focus is on delivering an amazing added experience to existing Xbox players and on empowering developers to scale to hundreds of millions of new players across devices," the company wrote in its announcement.

Meanwhile, Google's Project Stream will allow users to stream big budget, hardware intensive games in their Chrome browser. To demonstrate this, Google recently allowed its Project Stream beta testers to play *Assassin's Creed: Odyssey*. Announced within the space of a week, these new platforms will join PlayStation Now, which already allows PlayStation Network member to stream from the PlayStation back-catalogue to both consoles, PC and smart devices on a subscription basis. Alas, that service is not yet available in Australia. SP

Zombie dev shuffles into the sunset

The Walking Dead studio Telltale Games has effectively shut.

Known for its serialised, narrative-driven adventure games and big name licenses, California studio Telltale Games has effectively ceased operation. "Today Telltale Games made the difficult decision to begin a majority studio closure following a year of insurmountable challenges," the company said in its official statement, issued September 21. "A majority of the company's employees were dismissed earlier this morning." The studio is best known for its adaptations of *The Walking Dead*, *Batman* and *Minecraft*. It was set to adapt the Netflix series *Stranger Things*, but the future of that project is unclear.

While studio CEO Pete Hawley insisted shortly after the announcement that it wasn't a closure, the remaining skeleton staff of 25 has reportedly continued to shrink since September. Fans of the studio's serialised games, especially *The Walking Dead: The Final Season*, will still gain closure: in the wake of Telltale Games' closure, Skybound Games has announced it has acquired the license will finish the series. In the meantime, that game has been delisted from all digital storefronts. SP

"Today Telltale Games made the difficult decision to begin a majority studio closure following a year of insurmountable challenges."

Game developers begin clamping down on the sale of cheats

YouTubers and cheat devs sued by game owners.

A couple of days after the news broke that Epic Games was suing two YouTubers in the North Carolina District Court for their alleged use and subsequent broadcasting of *Fortnite* cheats, Rockstar upped the ante by fulfilling a search and seizure order on two properties in Melbourne believed to be harbouring individuals involved in selling the *GTA5* cheat software 'Infamous'. Rockstar Games and its parent company Take-Two received the go ahead from the Australian Federal Court to issue a restraining order on five individuals for the sale of *GTA 5* cheats and have frozen all the suspects' bank accounts (allowing only regular living expenses to be removed). In addition to this the Court mandated that search parties be admitted to two premises where they could search, copy, or remove anything deemed to be evidence or related to the sale of the 'Infamous' cheats. Infamous was reported to cost around US$40 and gave users access to infinite amounts of weapons, items and health, in addition to allowing players to teleport and kill opponents instantly. JB

Polish creator of *The Witcher* books wants US$16 million in royalties from hit games

DEVELOPER CD PROJEKT CALLS THE DEMAND 'GROUNDLESS'.

Expressing some serious seller's remorse, *The Witcher* creator Andrzej Sapkowski has filed a demand seeking an additional US$16 million in royalties from developer CD Projekt for the video game rights to his fantasy book series, as reported by *Eurogamer*.

While the Polish author was initially offered a percentage of the company's Witcher-related profits, he instead demanded up-front payment in full. "I was stupid enough to leave everything in their hands because I didn't believe in their success," Sapkowski lamented. "But who could foresee their success? I couldn't."

CD Projekt quickly responded to the demand, stating that "In the Company's opinion the demands expressed in the notice are groundless with regard to their merit as well as the stipulated amount." However, Sapkowski's lawyers claim the initial agreement only covered the first *Witcher* game, with its document stating that "distribution of all other games, including their expansions, add-ons etc., is, simply speaking, unlawful." CD Projekt responded by stating that it's looking to reach an "amicable resolution". SL

VR resolution

JOHN CARMACK AND ZENIMAX KISS AND MAKE UP.

Former id Software doyen and now Oculus VR CTO John Carmack has announced that the legal war between him and former employer ZeniMax has reached an end. That lawsuit was itself prompted by another: ZeniMax was awarded $US500 million in its lawsuit against Oculus VR, claiming that the latter's co-founder Palmer Luckey had violated an NDA. Carmack was also accused of borrowing ZeniMax-owned technology. SP

Sony admits it's working on the next PlayStation

BUT WHEN WILL THE PS5 ACTUALLY ARRIVE?

Sony is already developing a next-generation PlayStation, according to Sony president and CEO Kenichiro Yoshida. Speaking to the *Financial Times*, Yoshida said: "At this point, what I can say is it's necessary to have a next-generation hardware." While some analysts predict a 2020 or 2021 arrival for the PS4 successor, others believe it could land as early as Christmas 2019. SL

C&C remastered

COMMAND & CONQUER IS GETTING A SPIT AND SHINE FOR THE 21ST CENTURY

Electronic Arts looks set to remaster the classic *Command & Conquer* games, according to producer Jim Vessella. Following the release of the mobile-only *Command & Conquer: Rivals*, Vassella hit Reddit in order to assure series fans that EA still has grander plans for the much-loved 1990s RTS. "We've been exploring some exciting ideas regarding remastering the classic PC games, and already have the ball rolling on our first effort to celebrate the upcoming 25th Year Anniversary," Vassella said. SP

"It's a spectacle of how beautifully your machine can push pixels around, shaming every other open world racer with its graphical prowess."
HORIZON

PC, XBOX ONE X | $99.99 | WWW.FORZAMOTORSPORT.NET

Forza Horizon 4

Little Britain, big fun.

apc HOT PRODUCT

Ladies and gentlemen, we have only good news, if not the best of news: *Forza Horizon 4* may be the most perfect driving and racing games going. It is the gamer's game, boasting lush graphics and encapsulates the social nature of games.

Forza Horizon 4 is polished and generous in spirit, adding in new features and reworking familiar ones from every previous Horizon. It's a spectacle of how beautifully your machine can push pixels around, shaming every other open world racer with its graphical prowess while showing off the depth and breadth of its systems. This is so very 2018, and yet rolling updates mean you will be kept entertained for a long, long time to come.

Horizon 4 is a social game, encouraging play with other actual humans whether in traditional competitive play, or – in a nod to MMORPGs – working towards a common goal in hourly events so you can score exclusive rewards. Rack up 'influence' – XP by another name – by watching other people's streams on Mixer, and by broadcasting your own. Or, you can go totally solo if you want and still have a game that eclipses everything else on your console for sheer value.

Four hours in and you're into the game proper where the changing seasons permeate the bulk of your experience. Every week, on a Friday or Saturday depending on where you live, the game shifts into a new season. It's a clever and bold idea, forcing you to adapt to the altered landscape as you roam the map in freeplay.

Playground truly wants you to stay connected and engage with the world. Every hour on the hour, a Forzathon Live event invites all players on the map to one location and take part in a collective goal. Fellow racers are ghosts (thus cutting out disruptive, destructive trolling) and depending on the number of people who show up take a little under 10 minutes to wrap up before you're given a reward.

Playground has iterated on its reward structure over the last few games, and knows how to tap into the collectathon with its systems. Wheelspins are back and amped up with the chance to score cars, cash and clothing for your avatar, while every car has a skill tree that buffs its capacity to earn rewards.

No matter how you play, Horizon 4 is as dramatic as you want to make it. Jump in a rally monster, leave your viewpoint on the bonnet or in the cockpit and you'll feel the pressure of weaving a rally car through a forest while the trunks cast deadly shadows against the woodland, or pilot a hypercar down a freeway as the barrier flicks past while the needle on your speedo threatens to snap off as the motor yowls an opera of violence. Or you could spend your time tootling around the map in a convertible admiring the landscape.

Forza Horizon 4 is an ode to racing games. Playground has successfully infused the properly social DNA of MMOs into its racer, while never skimping on the handling model that makes their games so damned moreish and tactile. Anyone worried about series fatigue should feel relieved and embrace this fully. Do we have to spell it out for you? Get this, now.

■ Paul Taylor

Verdict

Close to perfection, this gorgeous racer is bursting with events and earns its place as a must-have.

★★★★★

Hospitals can end up being quite sprawling, and poor planning can lead to frustrated patients, emergencies and even death.

PC | USD$34.99 | WWW.TWOPOINTHOSPITAL.COM

Two Point Hospital

A cure for what ails you.

Make no bones about it, this is *Theme Hospital 2.0*. It pays such close homage to its inspiration that we should by all rights be criticising it. From the grid-based room construction to the quirky machines to cure equally quirky ailments, *Two Point Hospital* does nothing that Theme Hospital didn't already.

The core elements remain the same, starting out with a reception desk and assistant alongside a GP's office before adding to and expanding the hospital with various contraptions, treatments and the janitors to maintain them all.

The meta has been brought to the forefront, with close attention needed for items that bolster some function or value by a matter of slight percentages. The staff system is a great example of this, where rather than being restricted to just hiring a GP, psychiatrist or surgeon for specialist work, now doctors can learn traits that – alongside their own innate characteristics – help them work better within particular areas.

Building a room feels much like Theme Hospital, but with a greater variety of items to place.

The biggest success of *Two Point Hospital* is that it still remains compelling and fulfilling to play. Part of this is in the design of the levels: a smooth gradient that eases players into its mechanics and systems and always gives something new to learn or a challenge to overcome. The addition of a three-tier star system and in-level objectives will have those that get involved with the business sim side of things a little more to chew on, too.

It's clear that being passive about the decision-making process simply won't be enough; even a few stages in you'll quickly find patients dropping like lightbulb-headed flies and the cash reserves repeatedly plummeting into the red. It's not that *Two Point Hospital* is unfairly difficult, but it takes some failure to properly grasp what works. As you play you'll begin to discover where you're going wrong, and the next attempt will run so much more effectively.

This game has proven not only that business management games can be in demand again, but also why these games were popular to begin with. We're already holding out hope for *Two Point Funpark*, *Two Point Zoo* or even *Two Point God*. ■ **Robin Valentine**

Verdict

A modern take on a beloved title.

★★★★½

Prey: Mooncrash

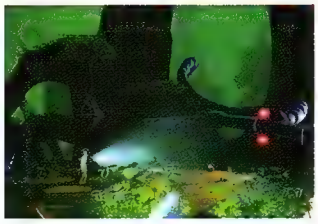
An unusual roguelite expansion for Arkane's 2017 FPS.

USD$19.99 | PC, PS4, XO | WWW.BIT.LY/PREYMOONCRASH

Mooncrash is *Prey's* curious spin on a roguelite, channelled within a story framework where you're entering a simulation of a Transtar base on the moon over and over again. It's somewhere between a new mode and a traditional expansion. There are five characters, each a different specialist. You start with one character, and follow objectives to unlock the others. You get a decent amount of new space to explore in *Mooncrash*, which feels smartly designed around its repeated format, and the way loot upgrades as you get deeper into the expansion is clever. So too is the structure, which even with its cyclical nature, uses its meta story to make you feel like you're moving forward.

Mooncrash feels like it was never intended for everyone to enjoy – it reaches out to a certain type of *Prey* player who will appreciate its systems in a purer form. For me, the slow progression holds it back a bit, but this is an innovative expansion that captures much of what I enjoyed about the base game. ■ **Samuel Roberts**

★★★½



Planet Alpha

Time changes everything.

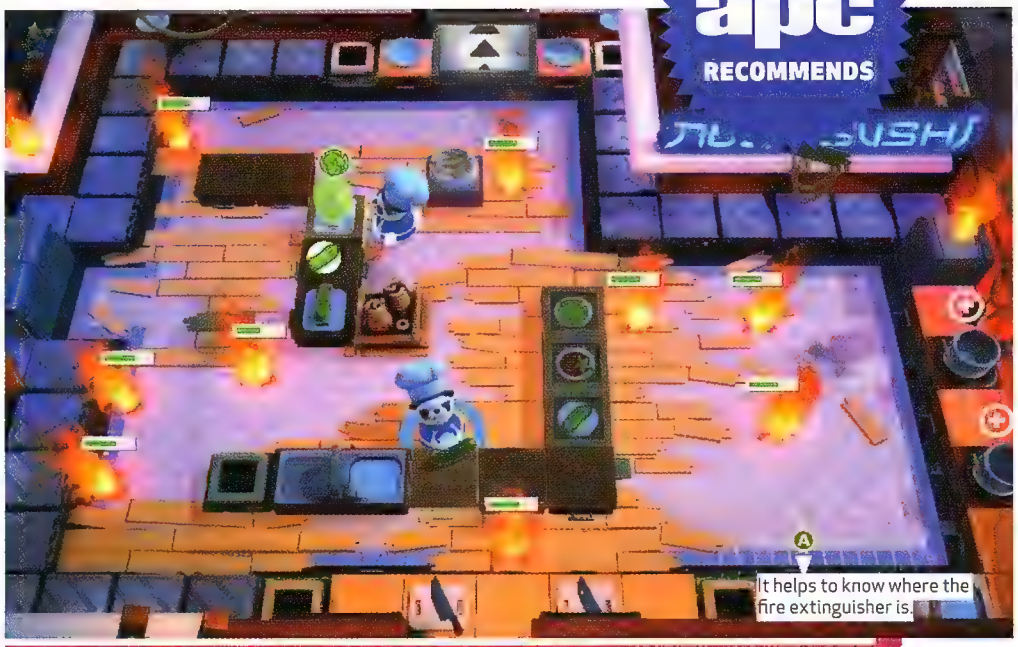
$27 | PC, PS4, XO, SWITCH
WWW.PLANETALPHAGAME.COM

The stunning visuals and vibrant colour palette bring this world, and the curious creatures that inhabit it, to life in a spectacular way. Unfortunately the very nature of the visuals can make it hard to distinguish a perilous pitfall or decipher an enemy's presence. This wouldn't be such an issue if each and every misstep in *Planet Alpha* didn't result in your instant demise. Every jump requires pinpoint precision and you need near inhuman reflexes to avoid falling between the cracks.

As you explore, you gain the ability to rotate the planet and manipulate its day and night cycle. This adds a unique puzzle mechanic that changes the environment, allowing impassable areas to be traversed by cycling to the appropriate time.

The platforming is interspersed with stealth sections. Evasion requires extremely accurate timing and even the slightest sighting will instantly net you a one-way ticket to oblivion. As with the platforming, most of the fun is lost by the game being far too particular. ■ Staff writers

apc RECOMMENDS



PC, PS4, XO, SWITCH | USD$25 | WWW.GHOSTTOWNGAMES.COM

Overcooked 2

A second helping of madcap meal-making.

Like the original, *Overcooked 2* is a cheerful, nonviolent co-op game that's simple enough for the whole family to enjoy. It also happens to be one of the most stressful games you'll ever play.

As before, your goal—whether you're playing alone, or with up to three other chefs—is to successfully serve as many dishes as you can within four minutes: chopping, mixing, frying and steaming ingredients according to the recipe. There's a wider variety of orders this time, including sushi and nuggets and fries but the processes themselves are still very simple. Multitasking so you can fulfil as many orders as possible in good time is where it gets tricky. On top of that you've got stage hazards that force you to adapt your processes, and that's when your careful planning starts to fall apart.

One of the big changes this time is that you can now throw raw ingredients, whether they're fresh from the pantry or just chopped. Often it's simply a useful time-saver, but sometimes you've no other option: on one stage, your 'kitchen' is actually two rafts hurtling down a river, while another forces you to lob items back and forth between a pair of hot-air balloons. Elsewhere, a rotating partition can split you up from a fellow chef, forcing them to pass over a half-completed dish so you can finish the job. It's incredibly satisfying to find your range and lob a patty into a pan—or a tortilla directly into the hands of your partner to finish one final burrito with a second to spare. In reality, you're as likely to end up inadvertently lobbing some tomatoes away in your confusion.

It's a reminder that there's a degree of awkwardness baked into *Overcooked* that can frustrate, but is ultimately the making of it. The interface is far from perfect: each dish is a mass of icons, sometimes obscuring whatever's in the space next to it. As such, it can be a struggle to tell when you've inadvertently taken a pan off the heat too soon, or why the game won't let you put one ingredient on a plate with something else. But that's the point. Kitchens are cluttered, chaotic places. If it was neater it wouldn't be nearly as funny: there would be fewer moments where you accidentally put fried meat in the sink, or place a saucepan of rice in the wrong place and wonder where the cheese has gone.

Online play is slightly underwhelming. The implementation is fine—public and private matches are available in both the standard arcade and competitive modes. But it's not quite the same as when you're sharing couch space and screen space with three others. *Overcooked* was made for good-natured bickering with people you know. As long as you're cooking with friends, you'll have a riotous time with a sequel that still offers one of the most deliciously chaotic multiplayer experiences on PC. ■ Chris Schilling

Verdict

Do you have a long online friends list, but are short of local multiplayer pals? This sequel was made for you.

apc RECOMMENDS

The football is slick and smooth, allowing you to play intricate passes of the kind that Guardiola and Klopp would be proud of.

PS4, XBOX ONE, PC | $90 | WWW.KONAMI.COM

PES 2019

Beautiful game, awful frame.

Continuing a trend that has defined the series in recent years, *PES 2019* brings joy on the field while wholly disappointing off of it. It's the Diego Maradona of football games if we're being generous. The Jamie Vardy if we're not.

There's a beautiful fluidity in the movement and actions of the players, a feeling that nothing is being corrupted or guided by underlying algorithms that are robbing you of your freedom to fully express yourself. Passing is crisp and playful, the ball going where your kick determines as opposed to being magically, magnetically pulled in by your intended recipient. Shooting is rewarding thanks to its diversity, while dribbling requires a careful touch to prevent the ball slipping from your feet.

Physics of this kind require you to be careful with how you play, with that same potential for variety of action manifesting itself equally as potential for failure. Get too cocky and you'll lose possession constantly; play too conservatively and you'll fail to outwit the opposition.

Nothing feels pre-scripted, allowing you to write your own stories and create your own sense of team dynamics and individual player impact. This means that no two matches ever feel the same and warms you with a sense of possibility if you're having to make last gasp changes in a desperate bid to save a result.

But then, there's everything else. The off-field action does its best to destroy any goodwill you had stored up. Master League mode, in which you play as and manage a team, hasn't seen a meaningful design upgrade in years. Presentation is shockingly old-fashioned. Genuinely. Shocking. Menus are so box-heavy that you would be forgiven for thinking that you're playing a warehouse simulator.

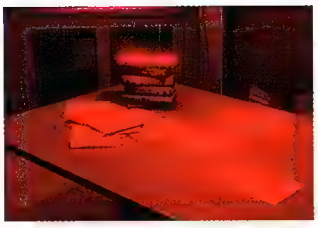
The fixes required are so obvious that it is even more frustrating to see them overlooked year after year. What's here is akin to a beautiful painting presented via the most ill-fitting, obnoxious frame.

■ Staff Writer

Verdict

Stunning on the field, awful everywhere else.

★★★★☆



Transference

Psych gaming.

PC, PS4, PSVR, RIFT, VIVE, XBOX ONE | USD$24.99
WWW.UBISOFT.COM

Transference is set in a single location that may be static but is never quite still. It's disturbing because its domestic setting is at once so recognisable yet clearly a few degrees away from normality. And in a more straightforward sense, it's a firstperson exploration game with some good scares.

Its premise imagines a piece of technology that can transmit one human consciousness into another. And who better to be the guinea pigs in such an experiment than one's own family? At least that's what Macon Blair's scientist – occasionally calm, often manic, consistently dishevelled – believes, but as we watch him entertainingly unravelling in a series of video logs, it's clear something has gone badly wrong. Hopping between his perspective, his musician wife and their son, we get to find out what that might be.

This isn't the kind of game that says 'Boo!' every five minutes, but there are jolts, and they're efficiently delivered. One deeply alarming set-piece leaves you trapped as a strange, hostile anomaly manifests nearby, with no exits to run to; another forces you to head directly towards a persistent banging noise instead of doing what comes naturally and fleeing. That's why, despite the occasional stumble, Transference will frequently leave you transfixed. ■ Staff writer

★★★½☆

"It was the sum total of all of these mechanics combining to create a wholly new gaming experience that shows the true innovative spirit of the game"

DEVELOPER: KONAMI COMPUTER ENTERTAINMENT TOKYO **PUBLISHER:** KONAMI **RELEASED:** 20 MARCH 1997 **SYSTEM:** PSONE, SEGA SATURN

GAME CHANGER

Castlevania: Symphony Of The Night

It went on to help define a genre of action platforming, but why was this classic ignored by many on release, and why is it so important today?

Hindsight being what it is, we can look back now at the launch of Castlevania: Symphony Of The Night and see beyond its initial poor sales figures and the fact that neither Konami or Sony seemed interested in supporting its PlayStation release with much advertising, and see how important and timely its arrival was for the future of gaming. While the industry at large (and most gamers with it) was intoxicated by the allure of 3D graphics and the new technical feats that could be achieved, the KCET team wanted to offer what felt like one last hoorah to the humble pixel art platformer. But in so doing, it managed to prove that there was still room for creativity and innovation in this field of game design, art direction and level design.

Directed by Toru Hagihara, who had steered the previous release Rondo Of Blood, and joined by assistant director Koji Igarashi (who would go on to work on Castlevania for the next 13 years at least), Symphony Of The Night was a merging of previous systems and mechanics from the Castlevania series, along with ideas from the best and brightest titles of the departing 2D era. One of the most vital changes was the non-linear progression through the castle as you travelled back and forth through different sections of the world, unlocking new abilities and grinding through demons in an effort to level up your abilities before tackling the next big challenge.

Of course, now we have a very simple, if not particularly elegant, word for describing this style of world design: Metroidvania. We're actually not massive

Key facts

- Part of the inspiration behind the more RPG elements of SOTN was apparently the team seeing copies of old Castlevania games in bargain bins in Japan, which they took as evidence that the series needed replay value.
- Depending on your performance as Richter Belmont in the prologue of the game, Alucard could start off the story with vastly improved stats or items already in his inventory.
- A hidden song can be found on track two of the game disc if it's placed in an audio player, although a message from Alucard also plays warning against doing this.

fans of this portmanteau, although we can't deny that it has proven to be a useful shorthand for games that have since been influenced by Super Metroid and this Castlevania release in particular. Symphony Of The Night was of course itself taking some of the Super Metroid formula and adding it to its traditional 2D action template, but the addition of deeper character progression systems and upgrades was something else on top. The introduction of the Inverted Castle, should you free rather than slay Richter Belmont, was also a massive twist, inviting repeat visits to the game to unlock new features and collect previously missed items. Castlevania became a living game experience that required interaction between fans, sharing of theories, and experimentation.

In isolation, so many of these features were not that new, which may be why Symphony Of The Night was criticised for lacking innovation by some quarters upon release, but looking back now, it was the sum total of all of these mechanics combining to create a wholly new gaming experience that shows the true innovative spirit of the game. Similarly, while on the surface of things the 2D graphics might be thought to be a retread of the past, offering little new compared to its 3D competitors, we can look back and see that with the mixture of 16-colour and 256-colour palettes, Konami was able to draw some of the most detailed and expressive characters models in gaming history, as well as some stunning world design.

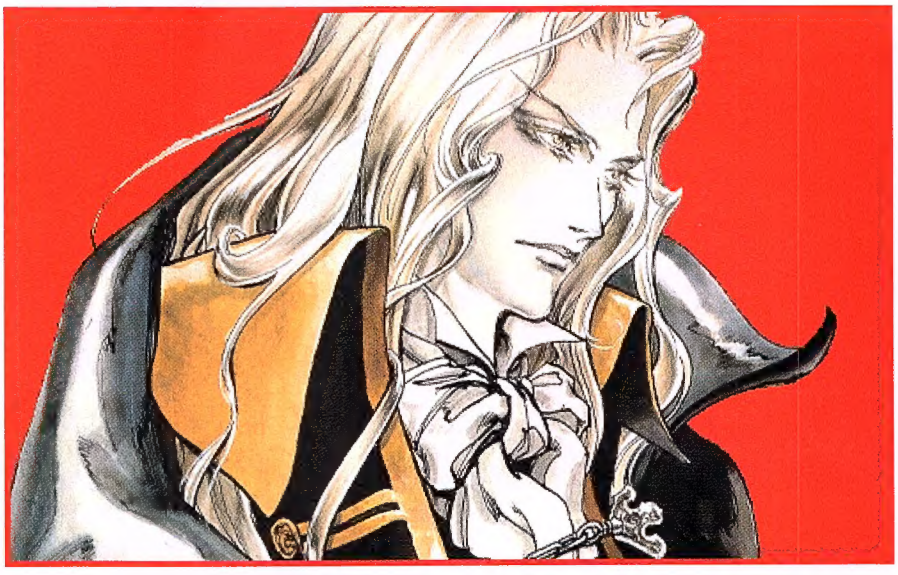
The additional power of the PlayStation, and shortly after the Sega Saturn when the game was ported to that system, may have enabled 3D rendered graphics, but they also allowed for incredible pixel density and variety. Symphony Of The Night expresses this best in its world design with the incredible richness and depth to its gothic architecture and interior decoration. Dracula's castle is packed with details and environmental elements that draw you into the world. Their pixelart, 2D design actually enhances them somewhat, as they can play against your expectations, offering interactivity or traps where you might otherwise not expect to find them.

So why is all of that important? Well, because the race towards 3D had started so quickly that few developers were asking if they were done perfecting 2D design. And of course, the answer was no, as Symphony Of The Night proved by improving on so much and pointing in the direction of improvements to come. Sony and Konami didn't believe much in the game's chances of success, and so there was little advertising for the North American release, and not many copies made either, but word of mouth spread eventually and the game quickly took on a cult following. In so doing it proved that there was a future for 2D experiences; that it remained a rich style of game design for developers to experiment with, and that there would always be an audience for such games out there.

Castlevania: Symphony Of The Night is the connective tissue that bridges the 16- and 32-bit generations, and by extension modern gaming, with classic videogame design. Along with Super Metroid, it came to define a style of non-linear action platforming and exploration games that we now call Metroidvania. It helped to launch the career of Koji Igarashi, who has continued to play in this field, embellishing and enhancing the template first established with this release. It brought us the incredible art direction of Ayami Kojima, who would work on the series until 2010 designing characters and painting its stunning artwork again and again. It showed us that the we weren't ready to leave our past behind just yet, and thanks to that lesson we continue to see incredible 2D work today. ■

The Key Characters

Symphony Of The Night brought back some classic characters in new roles.



Alucard

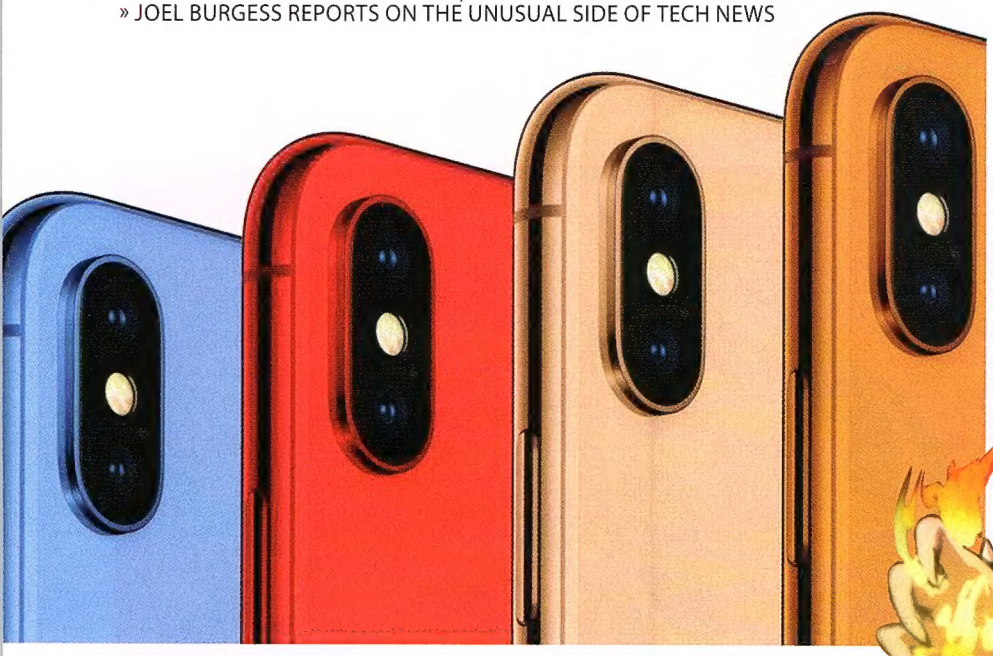
The half-human, half-vampire son of Dracula takes the lead here, but first appeared in Castlevania III: Dracula's Curse, challenging and then assisting Trevor Belmont in his quest to take down Dracula. His subsequent guilt over killing his own father leads him to go into a sort of hibernation until the events of SOTN.

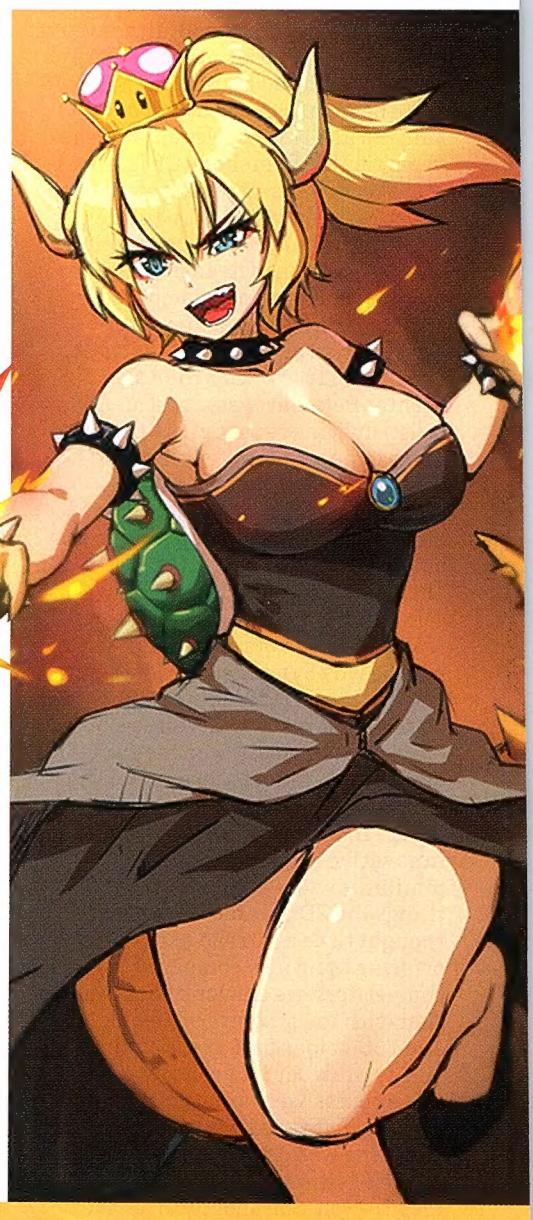
Richter Belmont

The hero of Castlevania: Rondo Of Blood returns at the start of Symphony Of The Night to retell the conclusion of his previous adventure, only to disappear shortly afterwards and then return claiming to be the new lord of Dracula's castle. He is, in fact, under an enchantment by Dracula's dark priest servant Shaft.

Dracula

The classic villain of the Castlevania series is once again resurrected, only to be put down, but this time he faces his own son, and as a result of this (and his discovering the final words of Alucard's mother to not harm humanity), he dies as something of a tragic figure rather than a personification of pure evil.





Brightly coloured tech will make you happier

Look at your tech through rose coloured glasses.

Choosing a colourful piece of tech has its risks. According to a new study many of us hold back on picking fruity flavours due to the fear that we'll regret the decision later. The study, published in the Journal of Consumer Research, suggests that consumer satisfaction is actually much higher and longer lasting for your first choice of colour. Scientists found that responders overestimated their irritation levels over time of vibrantly coloured devices and underestimated the amount of satisfaction they brought over time. So, in short, if you want colorful tech, don't whatever you do.

Coding error sends hundreds of new cars to be crushed

SUBAROOTED!

A costly software error on the production line for Subaru's 2019 Ascent SUV has resulted in 293 cars getting sent straight to the scrapyard. All of the Ascents built in July were found to be missing a critical series of spot welds on the B-pillar, which could increase the risk of passenger injury in a crash. According to a recall notice issued by the company, the miscoding of welding robots at the Subaru Indiana Automotive plant created an issue with "no physical remedy available". While only nine cars have been sold, any cars missing the welds will need to be destroyed in what's an expensive coding error.

NHL players banned from gaming on tour

CANUCKS BAN VIDEO GAMES FOR MORE THAN A FORTNITE.

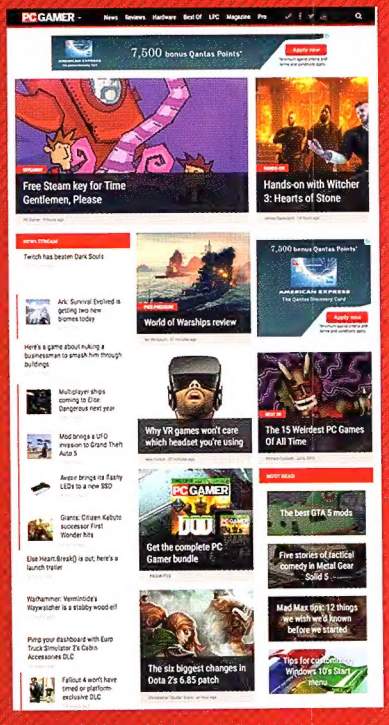
Whilst it's pretty common to see a ban on drugs, alcohol, and maybe even gambling for athletes when on tour, you wouldn't be alone in thinking that a ban on video games was an extreme measure for a team of professional (adult) NHL players. This however, is exactly what Vancouver's Canucks self-imposed in October. The blanket 'no gaming' measure seems to be a direct response to a few player's Fortnite habits. Bo Hovart, an alternate Captain for the Canucks and self confessed non-player of Fortnite said, "No more Fortnite" to TSN 1040 when announcing the ban. It says a lot about how addictive games can be when players are free to drink alcohol, but can't play video games while on tour.

Porn companies pounce on breakout Bowsette searches

INTERNET THINKS THAT GIRLY BOWSER IS THICC.

After Nintendo revealed that Toadette (chick Toad) could use a magic crown to take a human-like female form known as Peachette in the New Super Mario Bros. U, the internet started to wonder what other kinds of transformations this magic crown was capable of. What was surprising was just how much people 'love' Bowser's better half, now affectionately known as Bowsette. After a handful of PG fanart sketches, an overwhelming torrent of NSFW Bowsette images emerged, followed by cosplay videos, an awesome looking and perfectly respectable Zelda: Breath of the Wild mod and even (towards the end of the meme's life-cycle) a very low budget porn film called Super Mario Car.

SMARTER COOKIES ENABLED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